Ministry of Economic Affairs

Convention on Nuclear Safety (CNS)

National Report of the Kingdom of the Netherlands for the Sixth Review Meeting in April 2014

July 2013

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FIGURES

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LIST OF SYMBOLS AND ABBREVIATIONS

Abbreviation	**Full term**	**Translation or explanation (in brackets)**
ALARA	As Low As Reasonably Achievable	
ANS	American Nuclear Society	
ANSI	American National Standards Institute	
AOT	Allowed Outage Times	
ASME	American Society of Mechanical Engineers	
ATWS	Anticipated Transient Without Scram	
AVN	Association Vinçotte Nucléaire	(Nuclear safety inspectorate, Belgium)
Bkse	Besluit kerninstallaties, splijtstoffen en ertsen	Nuclear installations, fissionable materials, and ores Decree
BV	Besloten Vennootschap	Private company with limited liability
BWR	Boiling-Water Reactor	
Bvser	Besluit vervoer splijtstoffen, ertsen en radioactieve stoffen	Transport of fissionable materials, ores, and radioactive substances Decree
BZK	(Ministerie van) Binnenlandse Zaken en Koninkrijksrelaties	(Ministry of) the Interior and Kingdom relations
COSYMA	Code SYstem from MAria (MAria = Methods for Assessing the radiological impact of accidents)	(Computer code for radiological consequence analysis)
COVRA	Centrale Organisatie voor Radioactief Afval	Dutch central organisation for interim storage of nuclear waste
CSF	Critical Safety Functions	
CSNI	Committee on the Safety of Nuclear Installations	(OECD/NEA)

Abbreviation	Full term	Translation or explanation (in brackets)
ECCS	Emergency Core Cooling System	
ECN	Energieonderzoek Centrum Nederland	Netherlands Energy Research Foundation
EIA	Environmental Impact Assessment	
ENSREG	European Nuclear Safety Regulators Group	European group of regulators
EOP	Emergency Operating Procedure	
EPZ	NV Elektriciteits-Productiemaatschappij Zuid-Nederland	(Operator of Borssele NPP)
ESFAS	Engineered Safety Features Activation System	
ETC	Enrichment Technology Group Ltd	Subsidiary of Urenco and Areva, focussing on enrichment technology
ET-NL	Enrichment Technology Nederland B.V.	Subsidiary of ETC Ltd
EU	European Union	
EZ	(Ministerie van) Economische Zaken	(Ministry of) Economic Affairs
€	EURO	
FANC	Federaal Agentschap voor Nucleaire Controle	Belgian federal agency for nuclear supervision
GE	General Electric	
FRG	Function Recovery Guideline	
GBq	GigaBecquerel	(Giga = 10^9)
GKN	Gemeenschappelijke Kernenergiecentrale Nederland	(Operator of Dodewaard NPP)
GRS	Gesellschaft für Anlagen- und Reaktorsicherheit	(Nuclear safety experts organisation, Germany)
H_{eff}	Effective dose equivalent	

Abbreviation	Full term	Translation or explanation (in brackets)
HEU	High Enriched Uranium	
HFR	High Flux Reactor	Research reactor (in Petten, of the tank in pool type, 45 MW_{th})
HOR	Hoger Onderwijs Reactor	Research reactor (Delft Technical University)
HP&SC	Human Performance & Safety Culture	
HPES	Human Performance Enhancement System	
HSK	Hauptabteilung für die Sicherheit der Kernanlagen	Swiss nuclear regulatory body
I&C	Instrumentation and Control	
IAEA	International Atomic Energy Agency	
IEEE	Institute of Electrical and Electronic Engineers	
ILT	‘Inspectie Leefomgeving en Transport’	Inspectorate of the ministry of Infrastructure & the Environment
INSAG	International Nuclear Safety Advisory Group	(IAEA)
IPERS	International Peer Review Service	(IAEA)
IPSART	International PSA Review Team	Current name of IPERS (IAEA)
IRS	Incident Response System	
ISO	International Standards Organisation	
IWG-NPPCI	International Working Group on Nuclear Power Plant Control and Instrumentation	(IAEA)
JRC	Joint Research Centre of the European Communities	
KEMA	NV tot Keuring van Elektrotechnische Materialen	(Dutch utilities research institute)

Abbreviation	**Full term**	**Translation or explanation (in brackets)**
KFD	Kernfysische Dienst	Department for Nuclear Safety Security and Safeguards (The Netherlands)
KTA	Kerntechnischer Ausschuss	Nuclear Standards Technical Committee (Germany)
KWU	Kraftwerk Union	(Siemens nuclear power group, nowadays Framatome ANP)
LEU	Low Enriched Uranium	
LH	Licence Holder, licensee	
LOCA	Loss of coolant accident	
LPSA	Living PSA	
LTO	Long Term Operation	
MBq	MegaBecquerel	(Mega = 10^6)
MER	Milieu-effect rapport	Environmental Impact Assessment (EIA)
mSv	milliSievert	(Milli = 10^{-3})
µSv	microSievert	(Micro = 10^{-6})
MMI	Man Machine Interface	
MW_e	Megawatt electrical	
MW_{th}	Megawatt thermal	
NAcP	National Action Plan	National plan of the implementation of post-stress test measures
NDRIS	National Dose Registration and Information System	
NERS	NEtwork of Regulators of countries with Small nuclear programs	
NEA	Nuclear Energy Agency	(An OECD agency)
NPK	Nationaal Plan Kernongevallenbestrijding	National Nuclear Emergency Plan (The Netherlands)

Abbreviation	Full term	Translation or explanation (in brackets)
NPP	Nuclear Power Plant	
NRG	Nuclear Research and consultancy Group	(Private company uniting the nuclear activities of ECN and KEMA)
NRWG	Nuclear Regulators Working Group	(EU)
NUSS	Nuclear Safety Standards	(of the IAEA, old series)
NUSSC	Nuclear Safety Standards Committee	(IAEA)
NVR	Nucleaire Veiligheids-Richtlijn	Nuclear safety rules (The Netherlands)
OECD	Organisation for Economic Cooperation and Development	
OLC	Operational Limits and Conditions	
OSART	Operational Safety Review Team	(IAEA)
P&Id	Process and Instrumentation diagram	
PIE	Postulated Initiating Event	
PORV	Power-Operated Relief Valve	
POS	Plant Operational State	
PRA	Probabilistic Risk Assessment	
PSA	Probabilistic Safety Assessment	
PSI	Proliferation Security Initiative	Initiative under UNSCR 1540
PSR	Periodic Safety Review	
PWR	Pressurised-Water Reactor	
QA	Quality Assurance	
RB	Regulatory Body	
RHR	Residual Heat Removal	
RID	Reactor Institute Delft	(Operator of the HOR research reactor in Delft)

Abbreviation	Full term	Translation or explanation (in brackets)
RIVM	Rijksinstituut voor Volksgezondheid en Milieuhygiëne	National Institute for Public Health and the Environment (The Netherlands)
RPS	Reactor Protection System	
RPV	Reactor Pressure Vessel	
RSK	Reaktor Sicherheits Kommission	Reactor Safety Committee (Germany)
SAMG	Severe Accident Management Guidelines	
SAR	Safety Analysis Report	
SG	Steam Generator	
SGTR	Steam Generator Tube Rupture	
SR	Safety Report	Presents a summary of the most relevant information of the SAR.
SSCs	Structures, Systems and Components	
Sv	Sievert	
SZW	(Ministerie van) Sociale Zaken en Werkgelegenheid	(Ministry of) Social Affairs and Employment
TBq	TeraBecquerel	(Tera = 10^{12})
TCDF	Total Core Damage Frequency	
TIP	Technical Information Package	at Borssele NPP also known as. SAR
TMI	Three Mile Island	
TÜV	Technischer Überwachungs Verein	(Safety inspectorate, Germany)
URENCO	URanium ENrichment COrporation Ltd	
USNRC	United States Nuclear Regulatory Commission	
VGB	Verein Grosskraftwerk Betreiber	(Power plant owners group, Germany)

Abbreviation	**Full term**	**Translation or explanation (in brackets)**
VROM	Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer	Former (Ministry of) Housing, Spatial Planning, and the Environment
WANO	World Association of Nuclear Operators	
VWS	(Ministerie van) Volksgezondheid, Welzijn en Sport	(Ministry of) Health, Welfare, and Sport
WENRA	Western European Nuclear Regulators Association	
Wm	Wet milieubeheer	Environmental protection act

INTRODUCTION

This section sets out the purpose of the present report: '*Convention on Nuclear Safety – National Report of the Kingdom of the Netherlands for the Sixth Review Meeting in April 2014*'. It then continues with an overview of the national nuclear programme followed by a description of the national policy towards nuclear activities in the Netherlands and the main safety issues of the reporting period. The introduction finishes with a description of the structure of the report.

Purpose of the report
On 20 September 1994, the Netherlands signed the Convention on Nuclear Safety (CNS). It was subsequently formally ratified on 15 October 1996 and entered into force on 13 January 1997. The Convention obliges each Contracting Party to apply widely recognised principles and tools in order to maintain a high level of safety at its nuclear power plants. It also requires each Contracting Party to report on the national implementation of these principles to meetings of the parties to the Convention.

This report is the sixth in its series. It shows how the Netherlands meets the obligations of each of the articles of the Convention.

The information provided by this report applies to the situation of July 1st 2013 unless explicitly specified otherwise. At the review meeting in April 2014, the Netherlands will present the then available information.

Nuclear programme
The Netherlands has a small nuclear programme, with only one nuclear power plant, producing about 4% of the country's electrical power consumption. The programme features a number of steps of the nuclear fuel cycle. Some of the Dutch nuclear businesses have a global impact. Urenco, at the end of 2012, supplied 31% of world-demand for low-enriched uranium, of which its plant in Almelo, the Netherlands, provided a third. The company ET-NL in Almelo supplies all centrifuges for the enrichment plants of Urenco and Areva – world-wide. The High Flux Reactor (HFR) in Petten, on average supplies 70% of the European demand for radio-isotopes – and no less than 30% of the global demand. The Nuclear Research & consultancy Group (NRG) operates the HFR and several nuclear research facilities and in addition provides consultancy services to clients on several continents. In addition, scientists of the Dutch universities and NRG participate in many international nuclear research programmes.

According to Article 3 of the Convention, the Convention shall apply to the safety of 'nuclear installations'. Article 2 of the Convention defines 'nuclear installations' as civil land-based nuclear power plants and facilities located on the same site as the NPP and related to its operation. This introduction provides an overview of the facilities in the Netherlands that are subject to the Convention and those that are not.

Nuclear facilities subject to the Convention:
- In the South-West of the country in Borssele, the Netherlands' single operating nuclear power plant (NPP) is located. The technical details of this NPP are provided in Appendix 5 and the NPP is also addressed in the section on Article 6.
- In the East, near Arnhem, a small NPP (60 MW_e) is located. This installation is now in decommissioning, the plant is in so-called 'Safe enclosure'.

Nuclear Facilities not subject to the Convention:
- There are two research reactors in operation. One is located on the premises of the Delft Technical University (Hoger Onderwijs Reactor, HOR, 2 MW_{th}) and one located on the Research Location Petten (HFR, 45 MW_{th}).

- Additional nuclear research facilities and laboratories can be found in Delft (Technical University) and in Petten (Nuclear Research & consultancy Group, NRG and the EU Joint Research Centre, the JRC);
- In the Eastern part of the country in Almelo, there are facilities related to uranium enrichment of Urenco Netherlands (uranium enrichment) and Enrichment Technology Netherlands (ET-NL, development and production of centrifuge technology). The licensed capacity currently is 6200 tSW/a.
- In the South-West of the country, in the municipality of Borsele[1], the COVRA[2] interim radioactive waste storage facility is located. It has facilities for the storage of conditioned low, intermediate and high level waste. The latter category includes spent fuel of research reactors and waste from reprocessing of spent fuel of NPPs.. More information on COVRA can be found in the Netherlands' various editions of the national report for the Joint Convention on the Safe Management of Radioactive Waste and Safe Management of Spent Fuel.

Short history of the nuclear programme
The nuclear programme started with the construction of a research reactor in 1955, the High Flux Reactor in Petten, which achieved first criticality in 1961. It was originally thought that nuclear power would play an important role in the country's electricity generation programme. A small prototype reactor (Dodewaard NPP, 60 MW_e) was put into operation in 1968, and in 1973 this was followed by the first commercial reactor (Borssele NPP, 450 MW_e).

Although plans were made to expand nuclear power by 3000 MW_e, these were shelved following the accident at Chernobyl in 1986. Instead, the government ordered a thorough screening of the safety of both the then existing plants. This led to major back-fitting projects at both of them. The back-fitting project at Borssele was successfully completed in 1997. Meanwhile, mainly because of the negative expectations for the future of nuclear energy in the Netherlands, the small Dodewaard NPP was permanently shut down in 1997. In 2005 the owner of this NPP was granted a licence for a safe enclosure state for a period of 40 years, after which final dismantling shall commence.

In 2006 The Dutch government signed an agreement (the Covenant) with the owners of the Borssele NPP, which allows for operation until the end of 2033, at the latest. In the meantime the Covenant conditions should be met, in addition to the requirements of the licence. The aforementioned end-date of operation is also a requirement in article 15 (section a) of the Nuclear Energy Law. Refer to Appendix 6 for further information on the Covenant.

In 2009 plans were revealed by company Delta N.V.[3] and Essent/RWE for nuclear new build at the site of the NPP Borssele. Early 2012 both plans were shelved for (at least) a few years, considering the current economic environment and the uncertainties it introduced.

A new research reactor (named PALLAS) is under consideration in order to replace the HFR. Plans for PALLAS were initiated by company NRG, current LH and operator of the HFR. A foundation is being established that will conduct all preparatory activities required for the realisation of the new reactor. The national government and the province of North Holland together provided a loan of about 80 Meuro to finalize licensing and design of PALLAS. An important precondition for support is the realisation of a sound business plan and the acquisition of (private) funding for the constrtuction and operation of PALLAS.

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[1] Borsele (with one 's') is the name of the municipality in which the village of Borssele (with a double 's') is located.
[2] COVRA: Centrale Organisatie Voor Radioactief Afval, Dutch central organisation for interim storage of nuclear waste and spent fuel of research reactors.
[3] Delta is the majority shareholder of the current NPP but also generates power using coal, biomass, natural gas and wind.

The Technical University of Delft has launched a project to upgrade its research reactor (project Oyster). The project is jointly financed by the university and the national government.

The operation of the Borssele NPP and the plans for PALLAS and Oyster pose challenges for the Regulatory Body in terms of workload, required expertise and financial constraints. More about these issues can be found in the text on Article 8 'Regulatory body'.

National policy
The Netherlands is a parliamentary democracy. On behalf of the Dutch people, parliament scrutinises the Dutch government and approves laws and can propose lawmaking to the government. The parliament of the Netherlands is called the States General and is bicameral, i.e. it consists of two chambers: the House of Representatives (in Dutch: 'Tweede Kamer der Staten-Generaal') and the Senate ('Eerste Kamer der Staten-Generaal'). General elections for the House of Representatives are held at least every four years.

The government comprises the King, the Prime Minister, the other Ministers and the State Secretaries. The cabinet is the government, excluding the King. It formulates and is accountable for the government's policies.

Policy on new nuclear power
In the policy on nuclear power, guaranteeing nuclear safety has the highest priority. The minister of Economic Affairs[4] published in February 2011 a letter to Parliament on several aspects of nuclear energy, among which are the preconditions for nuclear new build in the Netherlands These preconditions present high-level requirements. Within the preconditions, it is up to commercial parties to invest in new nuclear power; in the liberalised energy market the government will not invest in power plants. The more technical preconditions address among others safety, waste management, decommissioning, mining, non-proliferation, and security.

Current policy also includes the requirement to take into account lessons learnt from the Fukushima Daiichi accident, as well as the outcomes of the European 'stress test' for nuclear power plants.

Policy on research reactors
October 2009, a statement from government backed the idea of the construction of a new research reactor, the PALLAS, to replace the High Flux Reactor (HFR) in Petten. A letter in support was sent from the cabinet to parliament. In this letter, three ministers, between them covering science, technology, planning, education, the environment and the economy supported the construction of PALLAS. In 2012, the national and local government have taken several steps to facilitate the organisation of a dedicated PALLAS organisation and the acquisition of private funding. The financing of the upgrade of the research reactor of the Technical University of Delft has also been arranged with the support of the national government.

Policy on the safe management of spent fuel and nuclear waste
Spent fuel management and waste management are not the subject of the Convention on Nuclear Safety, thus this topic is addressed only briefly in the present report. For more details, refer to the National Report for the 'Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management'[5].

Since the nuclear programme of the Netherlands is relatively small, both the total quantities of spent fuel and radioactive waste which have to be managed and the proportion of high-level and long-lived waste are modest. Most of the radioactive waste management activities therefore are centralized in one waste management agency, COVRA, operating its facilities at one site. In this way as much benefit as

[4] At that time, the ministry had a different name: ministry of Economic Affairs, Agriculture and Innovation.
[5] Published by the Netherlands in September 2011 for the Fourth Review Conference in May 2012.

possible is taken from the economy of scale. COVRA also manages radioactive waste from non-nuclear origin.

The policy in the Netherlands is that all radioactive wastes must be isolated, controlled and monitored. In principle this can be done by storage in buildings and institutional control. It can also be done by deep geologic disposal, in which case institutional control is likely to be discontinued at some moment. The current policy assumes that the radioactive waste will be stored in buildings for a period of at least 100 years. During this period the deep geological disposal is prepared financially, technically and socially in such a way that it can be implemented after the storage period. In the current policy it is assumed the disposal facility will be ready to receive radioactive wastes in 2130.

Part of the policy is also to have a research programme on underground disposal. The programme addresses among others issues like institutional control and prolonged retrievability of the waste from the repository. The current research programme is named OPERA[6].

The government policy on spent fuel management is that the decision on whether or not to reprocess spent fuel is in the first place a choice for the operator of a NPP. In the early days the operators have decided in favour of reprocessing their spent fuel for economic reasons, reuse of plutonium and reduction of the waste volume.

Reprocessing contracts have been concluded for all spent fuel generated by the current operating NPP until its end of operation. A new treaty was signed by the Republic of France and the Kingdom of the Netherlands on April 20, 2012, regulating for Dutch spent fuel (SF) produced after 2015, its receival by Areva NC in France, its reprocessing and the return of radioactive wastes from reprocessing to the Netherlands before 31 December 2052. It is envisaged that Parliamentary discussion of the enabling law for this treaty will be finished in 2014.

Main safety issues: Post-Fukushima Daiichi developments

March 11 2011 Japan was struck by an earthquake of enormous magnitude, followed by a devastating tsunami that affected large parts of its eastern coast. The tsunami killed thousands of people and caused enormous damage to Japanese cities and infrastructure. The Fukushima Daiichi nuclear power plant (NPP) shut down automatically, but it failed to adequately maintain all of its safety functions after being hit by the tsunami.

Following these events, the international communities have launched several interrelated initiatives to learn from these events and to initiate dedicated programmes to further enhance nuclear safety. For the Netherlands, the most important ones are 1) those led by the European Nuclear Safety Regulatory Group, ENSREG, the 'stress test[7] ', and 2) those led by the IAEA under the umbrella of the Convention on Nuclear Safety (CNS). The Netherlands has participated fully in all of the Fukushima-related initiatives of ENSREG and CNS.

All of the post-Fukushima Daiichi measures identified in the Netherlands are recorded in the Dutch National Action Plan (NAcP[8]) which was subject to European peer review in April 2013. The NAcP incorporates findings from the national assessment, the review under the umbrella of ENSREG and the review under the umbrella of the CNS[9] . The measures require actions at the License Holder (LH), but

[6] Dutch: 'Onderzoeksprogramma Eindberging Radioactief Afval', i.e. research programme on the final disposal of radioactive wastes.
[7] Stress test', more precisely formulated as 'Complementary Safety margin Assessment' (CSA).
[8] Netherlands' NAcP, National Action Plan (NAcP) for the follow-up of post-Fukushima Daiichi related activities, Report for the ENSREG-led NAcP Peer Review Workshop to be held in April 2013
[9] Findings from the 2nd Convention on Nuclear Safety (CNS) Extraordinary Meeting in August 2012. Also refer to 'The Netherlands' National Report For the 2nd Convention on Nuclear Safety (CNS) Extraordinary Meeting to be held in August 2012', published in May 2012

also some at the Regulatory Body (RB). However, various measures listed in the NAcP originate from the previously conducted regular Periodic Safety Reviews (PSRs) of the LH and not from the so-called ‘stress test’.

A condensed survey of the related measures planned or being executed in the Netherlands, can be found in the Summary of the present report.

It should be noted that the safety of *all* other nuclear facilities in the Netherlands has been evaluated in ‘stress tests’.

Structure of the report
This updated report follows the format of the previous national report for the Convention on Nuclear Safety, submitted in 2011. Because of the many developments regarding the regulatory framework in the Netherlands since the last report, and the many post-Fukushima Daiichi developments, the present report represents a major update. The present report complies with the guidelines presented in the update of INFCIRC/572/Rev.4[10]. In addition notice was taken of the lessons learnt from the 2nd Extraordinary Meeting of the CNS as recorded in the Minutes of the Officers’ Meeting for the 6th Review meeting of 29 October 2012 in Vienna, in particular its Annexes D and E.

The present report is designed to be a ‘stand alone’ document to facilitate peer review. Some information from the CNS National Report for the fifth CNS Review Meeting (CNS-5) was not repeated because it seemed less relevant, and readers are referred to that report for such information.

The report offers an article-by-article review of the situation in the Netherlands as compared with the obligations imposed by the Convention. It shows how the Netherlands meets the obligations of each of the articles established by the Convention.

The numbering of its chapters and sections corresponds to that of the articles in the Convention.

Chapter 2(a) relates to the ‘General Provisions’; it contains a description of the existing installations with their main safety characteristics and activities, as required under Article 6.

Chapter 2(b) describes the legislative and regulatory framework, the RB and the responsibility of the LH, as referred to in Articles 7, 8 and 9 respectively.

Chapter 2(c) describes the priority given to safety (Article 10), the financial and human resources (Article 11), the human factors (Article 12), quality assurance (Article 13), the assessment and verification of safety (Article 14), radiation protection (Article 15), and emergency preparedness (Article 16).

Chapter 2(d) describes the safety of installations, in terms of siting (Article 17), design and construction (Article 18) and operation (Article 19).

Several appendices provide further details of the regulations and their applications, and factual data, and references to other relevant material.

[10] Information Circular: Guidelines regarding National Reports under the Convention on Nuclear Safety, INFCIRC/572/Rev.4, 28 January 2013

SUMMARY

The Summary of the present report, presents in its Part I the information on the regular CNS-topics expected in a national report to the CNS. Because of the many post-Fukushima Daiichi measures, there is a special Part II in this summary, dedicated to those measures, as proposed in the Minutes of the Officers' Meeting for the 6th Review meeting of 29 October 2012 in Vienna.

PART I REGULAR CNS-TOPICS

Changes to legislative and regulatory framework

The basic legislation governing nuclear activities is contained in the Nuclear Energy Act ('Kernenergiewet' or Kew). It is a framework law, which sets out the basic rules on the application of nuclear technology and materials, makes provision for radiation protection, designates the competent authorities and outlines their responsibilities. More detailed legislation is provided by associated Decrees and Ordinances.

The Nuclear Energy Act has seen some changes since the publication of the Netherlands' 5th national report to the Convention in 2010, a prominent one establishing the minister of Economic Affairs as the principal responsible authority for conducting the regulatory process under the Nuclear Energy Act and for the main functions of the Regulatory Body. This change took effect in 2011.

The Regulatory Body (RB) is completing the new 'Dutch Safety Requirements' (DSR) for water cooled reactors. The DSR document is based on the IAEA Safety Fundamentals, several Safety Requirements guides and some Safety Guides, safety objectives published by WENRA and some other reputed sources. An annex to the DSR is dedicated to Research Reactors. More about this issue can be found in the text regarding Article 7 of the CNS.

Under the Nuclear Energy Act, a number of Decrees exist containing additional regulations related to the use of nuclear technology and materials. These continue to be updated in the light of ongoing developments. Notable is the update of the Decree on Radiation Protection (Bs).

The Council Directive 2009/71/EURATOM of 25 June 2009 establishes a Community framework for the nuclear safety of nuclear installations. In 2011, it was implemented in Dutch regulations[11]. The safety objectives of the Directive cover those of the Nuclear Safety Convention and are in some regards more specific and have a larger scope. As is the case in all member states of the European Union, EU regulations have a marked influence on Dutch lawmaking.

The comprehensive revision of the regulatory framework regarding nuclear safety and radiation protection is progressing.

More detailed information on legislation and the expected changes can be found in the sections on Article 7 of the Convention.

Special agreements

In July 2006 new French legislation entered into force, which prescribes that a return-scheme for the radioactive waste has to be formalised at the moment the spent fuel is sent to France. This condition also applies to the spent fuel that should be sent to France under the current contract between the operator of the Borssele NPP and AREVA. As a consequence a (new) bilateral agreement between the governments of the Netherlands and France was concluded. The Dutch government started the formal

[11] In 2011, implementation was done via a temporary ordinance (Stcrt. 2011, nr.12517), which was made permanent in 2013 (Stcrt. 2013, nr. 14320).

procedures to arrange this agreement by presenting a proposal to Parliament, establishing a return-scheme for the spent fuel under the current reprocessing contract. In 2009 the bilateral agreement between France and the Netherlands was signed. Parliament accepted the agreement by law of May 20th 2010[12]. A new treaty was signed by the Republic of France and the Kingdom of the Netherlands on April 20, 2012, regulating for Dutch spent fuel (SF) produced after 2015, its receival by Areva NC[13] in France, its reprocessing and the return of radioactive wastes from reprocessing to the Netherlands before 31 December 2052. It is envisaged that Parliamentary discussion of the enabling law for this treaty will be finished in 2014.

Regulatory body

For the purpose of this report, the ‘Regulatory Body’ (RB) is the authority designated by the government as having legal authority for conducting the regulatory process, including issuing authorizations, and thereby regulating nuclear safety, security, radiation protection, radioactive waste management and transport safety, but also supervision and enforcement. The separate entities of the RB reside in several ministries.

The minister of Economic Affairs (EZ) is the principal authority for conducting the regulatory process under the Nuclear Energy Act and for the main functions of the RB.

Plants operate under licence, awarded after a safety assessment has been carried out. The licence is granted by the RB under the Nuclear Energy Act. More about this can be found in the texts on Articles 7 and 8.

The long term operation (LTO) of the Borssele NPP and the current plans for nuclear new-build of the PALLAS research reactor, face the RB with major challenges like providing adequate number of government staff with sufficient expertise to oversee the licensing procedures. Anticipating increasing workload, the number of staff and budget has been increased.

Various organisational options are being evaluated that may strengthen the RB. Currently there are various organisations that together constitute the RB. A resolution requesting the development of the RB into one entity was accepted almost unanimously in Parliament on March 2013. The minister of Economic Affairs has endorsed the resolution. A proposal to establish one single national Authority for Nuclear Safety and Radiation Protection (ANVS[14]) is now being prepared, with a legal analysis of the possibilities. The proposal will satisfy international requirements. Various ministries are involved in the preparations that will establish ANVS as a competent and independent body for the regulation of nuclear safety, nuclear security, radiation protection, and waste management.

More information about the RB can be found in the text on Article 8.

Recent regulatory and safety issues

Borssele NPP

In February 2013 the licence for loading MOX became irrevocable. First fresh MOX fuel is expected in 2014.

The 10-yearly Periodic Safety Review (PSR) of the plant is ongoing. The third PSR evaluation report will be received for review by the RB by the end of 2013. Moreover, there are the post-Fukushima Daiichi measures and the associated implementation plan. Refer to Part II of this Summary for more on this. All of these (partly interrelated) projects will require a lot of attention of the RB and the Licence Holder (LH).

[12] Published in Government Gazette, year 2010, No. 238

[13] AREVA NC: AREVA Nuclear Cycle, subsidiary of the AREVA Group. The subsidiary provides services in all stages of the uranium fuel cycle.

[14] Dutch: ‘Autoriteit Nucleaire Veiligheid en Stralingsbescherming’ (ANVS).

Because the Borssele NPP is a relatively old plant, ageing is an issue requiring serious attention. There is a special Long Term Operation programme (LTO), and modernisation plans for its Instrumentation and Control (I&C) will spark discussions about 'digital I&C'.In 2013 the LTO-licence has entered into force. Before the end of 2013 various licence requirements have to be fulfilled, including the completion of the recommendations from the regulatory evaluation of LTO programme of the Licence Holder. In these recommendations the results of the SALTO mission of May 2012 have been considered. There will be a SALTO follow up mission in February 2014.

With concluding a Covenant in 2006 between the owners of the NPP and the government, several additional conditions were agreed for the continued operation of the NPP until the end of 2033. One of these was that Borssele will remain to belong to the 25% of safest water cooled and water moderated reactors present in Canada, the European Union and the United States of America. The Borssele Benchmark Committee was established to conclude whether Borssele NPP satisfies this requirement. It is expected the Committee will report its findings in September 2013.

In the summer of 2012, during a new type of in-service inspection conducted for the first time in neigbouring country Belgium, flaw indications were detected in the base metal of the Doel 3 and Tihance 2 reactor pressure vessels (RPVs). Checks carried out in the Netherlands in Borssele NPP, showed that the Borssele RPV does not present defects corresponding to those found in Belgium.

High Flux Reactor, HFR
This 45 MW_{th} research reactor in Petten is owned by the Joint Research Centre (JRC) of the European Commission. The LH and operator is the company NRG. Currently the 2nd Periodic Safety Review (PSR) is ongoing.

In 2010 a component of the primary cooling system was successfully repaired. This issue received international media attention because of the impact on the world-wide supply chain of medical isotopes. December 2012 there was an other issue with a component of the cooling system. Plans of the LH for the repair and system modifications were assessed and approved by the inspectorate of the RB. In June 2013 the HFR returned to service.

More details about the repairs can be found in the text about Article 6 and in Appendix 7 'High Flux Reactor (HFR)'.

Results of international peer review missions and implementation of their findings
In this section a selection of missions and implementation of their findings is presented.

- ENSREG Peer Review: in 2012 the Netherlands participated in the Peer Review of the stress test analyses in Europe. More details about implementation of findings are provided in section II of this Summary of the present report.
- WANO Peer Review: the WANO review of 2012 will have a followup in 2014.
- SALTO[15] mission: the IAEA SALTO mission of 2009 was succeeded in May 2012 by a full scope SALTO mission. Borssele NPP was required to perform an LTO assessment to demonstrate the safety of the plant for 60 years of operation, beyond its originally projected 40 years of operational life horizon in October 2013. This SALTO mission was in support of and has reviewed details related to this LTO assessment. For details refer to Appendix 8.
- IPSART: International Probabilistic Safety Assessment Review Team. The most recent IPSART mission to Borssele NPP has been carried out in April 2013. This was a follow-up to the mission in 2009. For details refer to Appendix 8.

[15] SALTO: Safe Long Term Operation Review Services

- IRRS: The RB has requested an International Regulatory Review mission. It will visit the Netherlands' nuclear RB in the last quarter of 2014. In preparation, the RB is executing an IRRS self assessment in 2013.
- OSART: The RB has requested an operational safety review (OSART) mission in line with the IAEA Action Plan on Nuclear Safety. The mission to Borssele is scheduled for September 2014 and contains two extra modules: Independent Safety Culture Assessment and Corporate OSART. The previous OSART mission to the Borssele NPP was in 2005.
- Dutch Safety Requirements (DSR): in 2013, the new DSR was reviewed by a team of the IAEA.

Drills, exercises and lessons learnt

In the Netherlands very large scale exercises for emergency preparedness are current practice. Recent examples are:

- 'Indian Summer', October 2011, evaluation in 2012. This was a large scale exercise[16] in emergency Preparedness and Reponse and Post Accident Management off-site, with about 1,000 staff participating. This is a reoccurring event. Lessons learnt have led to reviewing the relation and structure of the of EPAn with the structure of the National Crisis Management System. EPAn[17] is the National Nuclear Assessment Team. It advices the policy teams at local and national level when there is a threat of an off-site emergency in a nuclear installation or a radioactive release in the Netherlands or a neighbouring country.
- 'WakeUp', March 2012, a two-week-long large scale exercise near various power stations of a mechanised army brigade in cooperation with civil units. This is a recurring event. Near the NPP, a flooding was simulated. The army arranged and transported fuel, food and staff to predetermined buildings on the NPP site, in accordance with the NPP's Emergency Response Organisation's requirements. The exercise proved that the army was capable to give the required support to the NPP under flooding conditions.

Actions on transparency and communication with the public

Parliament is actively informed by the RB via the minister of Economic Affairs. All national and EU reports releated to the 'stress test' analysis and Peer Review have been sent to Parliament and are also available on the government website. In addition to the English version of reports, a Dutch translation or Dutch summary is provided. Early 2012 in the Netherlands a public meeting was organised, focused on the results presented in the National Report on the stress test of the Dutch NPP.

Stakeholder involvement is embedded by public consultation during the licencing process and if applicable in the process of the Environmental Impact Assessment (EIA) under the Environmental Protection Act. This process also involves meetings of RB, Licence Holder (LH) and the public. The RB is transparent in its communication of regulatory decisions to the public (e.g. on licence applications and adequacy of 'stress tests'); these are published with supporting documentation.

The RB is aware of the different backgrounds of informed groups and the general public. The ministries, of which the RB is part of, often produce easy to understand press releases, as well as detailed reports. Of some reports, there are detailed as well as summary versions (in the Dutch language). The RB publishes its findings related to the performances of the LHs on governmental websites.

[16] It was noted by the ENSREG peer review that such large scale exercises are a good practice
[17] Dutch: 'Eenheid Planning en Advies nucleair', EPAn.

The operator and LH presents its activities via local presentations at meetings, dedicated websites and publicly available reports.

ENSREG and the European Commission on 17 January 2012 in Brussel organised a Public Meeting for authorities, Licence Holders, NGOs, media and the general public. The purpose of the meeting was to inform about the European stress test of NPPs and the associated peer review process and have discussions about these.

Important issues identified in previous report and follow-up

This section is devoted to the main remarks made during the fifth review meeting of the Contracting Parties to the Convention on Nuclear Safety in 2008. Emphasis is given to the remarks made specifically in relation to the Dutch situation.

For questions answered via the CNS-website during the peer review process of 2010/2011, reference is made to the Q&A section of the CNS website, hosted by the IAEA.

During the fifth CNS Review Meeting, several challenges facing the Dutch RB were identified.

- *Coordination of the tasks and their execution of the two branches of the Regulatory Body*
  The RB is mainly constituted of two entities (NIV and KFD), but both under the authority of the minister of Economic Affairs. NIV is responsible for licensing and regulations (but not involved in policies on energy), KFD is responsible for supervision and enforcement. Coordination is provided and will be subject to review in the IRRS self assessment. There are plans to integrate the several entities constituting the RB into one national Authority, refer to the section on 'Regulatory Body' in this Summary.
- *Knowledge transfer, internalizing and using knowledge from abroad for the assessment of the design and drafting the licence (conditions) for new nuclear power plants*.
  Since the 5th review meeting, the plans for new build have diminished; both plans for building new NPPs in the Netherlands have been shelved. However the plans for the new Research Reactor PALLAS remains and an upgrade of the Research Reactor of the Technical University of Delft is underway (project Oyster).
- *Supplying in adequate numbers, suitably qualified and experienced staff for the licensing procedures associated with the continued operation of the Borssele NPP and licensing of nuclear new build*.
  Recently the RB staffing has been strengthened and the staff receives dedicated training. A sustainable solution for the associated budgets in the future is being pursued. Part of the solution is the establishment of a new RB organisation with guarantees for its robustness. The safety framework in the Netherlands includes the LH, and the RB. Organisations are contracted to support the RB with various tasks, support is also provided by foreign TSOs and national and international consultancy organisations.

PART II POST-FUKUSHIMA DAIICHI MEASURES

Participation of the Netherlands in international self assessment exercises

The Netherlands has participated fully in the post-Fukushima Daiichi activities led by ENSREG and by the IAEA (under the CNS umbrella). The Licence Holder (EPZ), operating the NPP Borssele, also participated in two post-Fukushima WANO self assessment exercises. The stress test benefited from these WANO self assessments. The results of these assessments are included in the 'stress test' results.

The National Action Plan (NAcP[18]), was finalized in December 2012 and was subject to European peer review in April 2013, gives the most complete survey of all post-Fukushima Daiichi actions, that will be implemented by the Licence Holder (LH). It should be noted that some actions in the NAcP stem from regular Periodic Safety Reviews and other regular safety assessments, rather than from the so-called 'stress test' and the successive peer reviews.

Section 8 of the NAcP gives a tabled summary of the national implementation of post-stress test actions. It features two tables, one table with the Actions initiated by or imposed on LH EPZ, and an other table with Actions mainly for the Regulatory Body (RB). These tables have been reproduced in Table 0 1 and Table 0 2 in the present report.

Several Good Practices have been identified earlier in the Peer Review Country report on the Netherlands' National Report on the stress test of NPP Borssele. Amongst others, the Peer Review identified:

- Redundancy of power supply (two independent systems for Emergency Diesel Generators), and the coal fired power station nearby with its own diesel generators and linked to the NPP.
- Fully qualified alternate Ultimate Heat Sink (UHS) consisting of 8 deep water wells.
- Use of risk monitor for planning maintenance during operation and outages.
- Explicit incorporation of international standards (e.g. those of IAEA, WENRA) into the licence via the Nuclear Safety Rules (NVRs) approach.
- SAMGs[19] for all operational states (including shutdown). The LH has been very proactive in this regard, implementing them far faster than in many nations reviewed.
- A full scope Level 3 PSA for deriving its severe accident management strategies (many nations reviewed are still developing Level 2 PSAs) which has been subject to IAEA IPSART missions.
- The scale of emergency exercises which is unusually large by international standards – a national exercise in 2011 involved 1000 people.
- PARs[20] are already installed that are designed for severe accident conditions - in many other nations, PARs are either in the process of being installed or are only designed for design basis events.

Some results from the Peer Review of the NAcP are:

- The Netherlands' NAcP informs comprehensively and well understandable on how the Borssele NPP in the Netherlands is about to implement various observations and conclusions according to the National assessments, the recommendations and suggestions of the European Stress Tests and the conclusions of the CNS process.

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[18] Netherlands' NAcP, National Action Plan (NAcP) for the follow-up of post-Fukushima Daiichi related activities, Report for the ENSREG-led NAcP Peer Review Workshop to be held in April 2013

[19] SAMGs: Severe Accident Management Guidelines

[20] PARs: Passive Autocatalytic Recombiners

- Among many other good practices a long term practice of Periodic Safety Reviews and a comprehensive practical use of Probabilistic Safety Assessments have been pointed out during the Peer Review.
- Within the frame of the ongoing Periodic Safety Review and the NAcP also the possibilities for in-vessel retention of molten core are investigated. Finding a solution constitutes a challenge, in view of the design characteristics of the Borssele NPP. It is suggested that the Netherlands takes note of progress made in this area in other countries and solutions already adopted.
- The implementation of improvement measures is clearly scheduled. Progress will be reported by the LH in three month intervals. The timeframe to implement all the improvement measures until end of 2016 is ambitious and commendable.
- Regular information of Parliament as well as inclusion of the other nuclear facilities in the stress test exercise can also be seen as good practices.

Tabulated lists of post-Fukushima Daiichi actions

The following two tables present the post-Fukushima Daiichi actions in the Netherlands. They have been reproduced from the Netherlands' NAcP.

Table 1 National post-stress test Actions – initiated by or imposed by RB on LH (operator of one NPP unit) – Status April 2013

NL Action No.	Topic	Action / Activity	Related Recommendation No. on European Level	Status	Finalization
1 (M1)	SAM	Emergency Response Centre (ERC) - study and consider options to better protect ERC like alternative location ERC, new building, strenghtening current building etc.	1, 8, 22, 27, 32, 44	in progress	end 2014
2 (M2)	SAM	Storage facilities for portable equipment (needed for accident management), study and consideration of options to improve resistance against external hazards	1, 8, 27, 32, 44	in progress	end 2014
3 (NR 7.3.1)	design issues	Improvement of accessibility under extreme conditions	32, 44	in progress	end 2014
4 (PR 4.2.4.2)	SAM	Analysis of potential doses to workers	22, 32, 43, 44	in progress	April 2013
5 (NR 6.1.5)	SAM	Reassessment of ERO Staffing regarding its adequacy 24/7	35	in progress	eval March-2013 impl end-2013
6 (M3)	SAM	A possibility for refilling the spent fuel pool without entering the containment - this will increase the margin to fuel damage in certain adverse containment conditions.	23	implemented	end-2012
7 (M4)	SAM	Additional possibilities for refilling the spent fuel pool - this will increase the number of success paths and therefore increase the margin to fuel damage in case of prolonged loss of spent fuel pool cooling.	23	in progress	end-2013
8 (NR 7.3.1)	SAM	Improvement of possibilities to sustain cooling SFP *- this is covered under action 7 (M4).*		refer to 7	

NL Action No.	Topic	Action / Activity	Related Recommendation No. on European Level	Status	Finalization
9 (M5)	SAM	Reduction of the time necessary to connect the mobile diesel generator to Emergency Grid 2 to 2 hours - this will increase the margin in case of loss of all AC power supplies including the SBO generators.	15, 26	in progress	apr-13
10 (M6)	SAM	Establishing ability to transfer diesel fuel from storage tanks of inactive diesels to active diesel generators. Phase 1: emergency grid 1 EDGs, Phase 2: remaining diesels.	15, 17	in progress	mid-2014
11 (M7)	SAM	Establishing independent voice and data communication under adverse conditions, both on-site and off-site, would strengthen the emergency response organisation. Includes evaluation current means, procurement satellite communication apparatus, and arrangements with Ministry of Defence.	35	in progress	end-2013
12 (M8)	Ext Events / Nat Hazards	Ensuring the availability of fire annunciation and fixed fire suppression systems in vital areas after seismic events - this will improve fire fighting capabilities and accident management measures that require transport of water for cooling/suppression.	7, 32	in progress	studies mid-2014 impl's end-2016

NL Action No.	Topic	Action / Activity	Related Recommendation No. on European Level	Status	Finalization
13 (NR 7.3.1)	design issues	Quality fire fighting systems buildings 01/02 and 35 for a DBE. *This is covered under action 12 (M8).* [The fire fighting systems in buildings 01/02 (dome) and 35 (backup control room) are not designed for operability after occurrence of the design base earthquake (DBE). To enhance their reliability after a DBE they should be qualified. However, any enhancement should be based on the results of the proposed advanced seismic analysis. This position is linked to LH's proposal S3 (Action 33) but also (for implementation) to its measure M8 (Action 12).]		refer to 12	
14 (M10)	Ext Events / Nat Hazards	Ensuring the availability of the containment venting system TL003 after seismic events - this will increase the margin in case of seismic events.	3, 31, 32, 48	in progress	studies end-2013 impl's end-2016
15 (NR 7.3.1)	design issues	Technical and organisational improvement of availability under earthquake conditions of systems for containment filtered venting and fire fighting - should be based on results of advanced seismic analysis. *This is covered in actions 12 (M8) and 14 (M10).*		refer to 14 & 12	
16 (M9)	design issues	Increasing the autarky-time beyond 10 h - this will increase the robustness of the plant in a general sense.	16	in progress	studies end-2012 impl's end-2016
17 (NR 7.3.1)	design issues	Increasing the autarky time beyond 10 hours (M9). Further study to define its proper implementation. *This is covered in action 16 (M9).*		in progress	Sep-13

NL Action No.	Topic	Action / Activity	Related Recommendation No. on European Level	Status	Finalization
18 (M11)	Ext Events / Nat Hazards	Wave protection beneath the entrances to the bunkered back-up injection- and feedwater systems and to the bunkered emergency control room - this will mitigate the sensitivity to large waves combined with extreme high water and will make the plant fully independent from the dike.	8	in progress	mid-2013
19A (P1)	SAM	Develop set of EDMGs and implement training program (phase 1)	17, 27, 29, 30, 32, 45	in progress	end-2013
19B (P1)	SAM	Develop set of EDMGs and implement training program (phase 2)		in progress	end-2013
20 (NR 7.3.2)	SAM	Developing set of EDMGs - This is covered in action 19A and 19B		refer to 19	
21 (P2)	SAM	Training of the procedure to ensure water supply during mid-loop operation and loss of AC power	19	implemented	end-2012
22 (PR 3.3)	SAM	Prepare and validate capabilities to cope with SBO during mid-loop operation.	19	in progress	study end-2012 impl's end-2013
23 (P3)	Ext Events / Nat Hazards	Develop check-lists for plant walk-downs and the necessary actions after various levels of the foreseeable hazards		in progress	extr weather & flooding: Jan 2013. earthquakes: May-2014
24 (NR 6.1.5)	SAM	Training of long term SAMG measures	34, 47	in progress	study end-2013 training March-2015
25 (PR 4.2.2.2)	SAM	Develop specific SAMG for SFP	34, 47	in progress	end-2013

NL Action No.	Topic	Action / Activity	Related Recommendation No. on European Level	Status	Finalization
26 (PR 4.2.4.2)	SAM	Improvement of SAMGs and EOPs focusing on long term accidents. Operator EPZ will also become member of the Westinghouse Owner Group	33, 34, 47	in progress	end-2013
27A (NR 7.3.2)	SAM	Assessment of the need to upgrade equipment and/or instrumentation dedicated to SAM purposes (hardened core approach). Part A includes: study increasing robustness existing equipment & study protection of equipment against BDB extreme hazards	1, 17, 18, 32, 33, 47	in progress	end-2013
27B (NR 7.3.2)	SAM	Assessment of the need to upgrade equipment and/or instrumentation dedicated to SAM purposes . Part B includes study of accessibility of locations for manual operation, including relocation options.	1, 17, 18, 29, 32, 33	in progress	end-2013
27C (NR 7.3.2)	SAM	Assessment of the need to upgrade equipment and/or instrumentation dedicated to SAM purposes. Part C includes study of periodic test/inspection programs for equipment & of well defined and trained procedures to use the equipment.		in progress	end-2013
28 (NR 7.3.2)	SAM	Develop set of clear criteria to provide a basis for deciding when to switch the turbine oil pump off to increase the battery time. Disabling this pump will damage the turbine		implemented	end-2012
29 (S1)	SAM	Study of a reserve SFP cooling system independent of power supply. This is also addressed in action 7 (M4).	19, 23	in progress	study end-2013 impl's end-2016

NL Action No.	Topic	Action / Activity	Related Recommendation No. on European Level	Status	Finalization
30 (S2)	Ext Events / Nat Hazards	Investigate measures to further increase the safety margins in case of flooding (survey & analysis). When needed, proposal for modifications and implementation.	13	in progress	study end-2012 impl's end-2016
31 (NR 7.3.3)	Ext Events / Nat Hazards	Study flooding - this is covered by action 30 (S2).		refer to 30	
32 (PR 2.3.3)	Ext Events / Nat Hazards	Study super storms - this is covered by action 30 (S2).		refer to 30	
33 (S3)	Ext Events / Nat Hazards	Study Seismic Margin Assessment, this includes various studies: Study SMA and SPSA methods Evaluation KNMI: Recommendation study 'Seismic Hazard in context IAEA' Drafting of proposal SMA Determining RLE Undertake SMA	7, 13, 23	in progress	end-2013
34 (NR 7.3.3)	Ext Events / Nat Hazards	Study SMA - this is covered by action 33 (S3)		refer to 33	
35 (PR 2.1.3)	Ext Events / Nat Hazards	Consider update hazard assessment, including DBE and liquefaction. *This is covered by action 33 (S3)*		refer to 33	
36 (S4)	design issues	Study on strengthening off-site power supply, includes studies and when needed implementation.	15	in progress	end-2013
37 (S5)	design issues	Study more extensive use of steam for powering an emergency feed water pump; includes studies and when needed implementation.	15	in progress	studies end-2013 impl's end-2016
38 (S6)	Ext Events	Study impact aircraft impact on safety functions		in progress	end 2013

NL Action No.	Topic	Action / Activity	Related Recommendation No. on European Level	Status	Finalization
39 (S7)	design issues	Study hydrogen threat to containment. The NPP has ample provisions to deal with this threat. Nevertheless additional studies will be undertaken.	31	in progress	March 2014
40 (NR 7.3.3)	External Events	Water accumulation if drain pipes are blocked during fire fighting; studies and when needed implementation of measures. The studies will also cover prevention of freezing of underground piping, other weather related hazards.		in progress	mid-2014
41 (PR 2.3.3)	External Events	Study freezing of underground piping, operation of diesels in cold conditions, effects of snow. *This is covered in action 40*.		refer to 40	
42 (NR 5.1.5)	SAM	Study amount of lubrication oil (for diesels) in crisis situations	17	in progress	mid-2014
43 (NR 5.1.5)	design issues	Re-assessment of alternative power sources (alternative to emergency grids). This includes planning and implementing extra external connection points for mobile diesel generator and the fire fighting system (water supply)	15, 16, 22, 26	in progress	Jan-14
44 (PR 4.2.4.2)	SAM	Better arrangements for mobile diesel generators and batteries. This includes study of small emergency power generators or fuel cells as a means for recharging or backup power. Possibly also instructions for recharging or switching to such power sources.	16, 22, 26	in progress	study mid-2013 impl end-2013
45 (NR 6.4.3)	SAM	Study of procedures for handling of large amounts of radioactively contaminated water. Includes study & when needed implementation.		in progress	study mid-2013 impl end-2013

NL Action No.	Topic	Action / Activity	Related Recommendation No. on European Level	Status	Finalization
46 (PR 4.3)	SAM	Unambiguous tagging of keys of rooms in bunkered building (ECR). Keys will be numbered and the necessity of having SAMG documentation in the ECR will be evaluated.		implemented	2012

Table 2 National post-stress test Actions – acting on and initiated by the national RB

NL Action No.	Topic	Action / Activity	Related Recommendation No. on European level	Status	Finalization
RB-4.001	national organisation	The RB is drafting requirements for the design and construction of new nuclear reactors - they will be implemented in the regulatory framework.	101	in progress	draft 2013 final 2014
RB-4.002	national organisation	The RB is in the process of drafting requirements related to internal & external hazards - they will be implemented in the regulatory framework.		in progress	draft 2013 final 2014
RB-4.003	national organisation	The RB is studying new financing mechanisms for handling of licence applications and supervision.	102	in progress	2014
RB-4.004	national organisation	RB evaluation in the framework of the IRRS self assessment and coming IRRS mission. In the self-assessment the RB will take notice of the xCNS summary 'Action oriented objectives for strengthening Nuclear Safety'.	102	in progress	2014

NL Action No.	Topic	Action / Activity	Related Recommendation No. on European level	Status	Finalization
RB-4.005	national organisation	Consequences of German phase out. The Dutch RB will study the possible long term impact of the German phase out on the operation of the German-design Dutch NPP. The Dutch RB will evaluate the possibility to increase exchange information with other regulators of German design plants like Spain and Switzerland.	131	in progress	2014
RB-4.006	national organisation	In the light of the self-assessment within the framework of the IRRS-mission special attention will be paid to explain the management of Safety Culture within the Regulatory Body.	135	in progress	end 2013
RB-4.007	national organisation	The Netherlands is implementing the IAEA action plan. A number of actions are already practice, like the adoption of the IAEA-regulations, the IAEA missions, and evaluation and strengthening of EP&R.		in progress	no end date
RB-4.008	national organisation	Taking into account the European developments on this matter, research is in progress into clearance levels and protocols for measurement, decontamination and clearance, applicable to clearance of containers and other materials		in progress	end 2013
RB-5.001	EP&R	Planning and organisation of bilateral exercises with Belgium and Germany is ongoing.	111	in progress	no end date
RB-5.002	EP&R	Damage to infrastructure (hampering EP&R activities) is subject to renewed evaluation in the light of post-Fukushima learning	108	in progress	no end date
RB-6.001	international cooperation	Drafting and publishing national report for CNS 2014		planned	August 2013

NL Action No.	Topic	Action / Activity	Related Recommendation No. on European level	Status	Finalization
RB-6.002	international cooperation	EU/ENSREG, participation in Peer Review Workshop regarding National Action Plans (post Fukushima measures)		planned	April 2013
RB-6.003	international cooperation	EU/ENSREG, participation in workshops 'Natural Hazards' and 'Emergency response', publication guidance documents planned for review.		planned	Nat Haz, June 2013 Em zones, March 2013
RB-6.004	international cooperation	Harmonisation effort with neighbouring countries regarding emergency countermeasure zones (and associated intervention levels) and responses		planned	2014
RB-6.005	international cooperation	Two workshops of Dutch RB with peers in Belgium (FANC)		planned	2013
RB-6.006	international cooperation	Collaboration in international forums is continued	101	in progress	no end date
RB-6.007	international cooperation	cooperation with foreign TSOs		in progress	no end date

CHAPTER 2(A) GENERAL PROVISIONS

ARTICLE 6. EXISTING NUCLEAR INSTALLATIONS

6. Each Contracting Party shall take the appropriate steps to ensure that the safety of nuclear installations existing at the time the Convention enters into force for that Contracting Party is reviewed as soon as possible. When necessary in the context of this Convention, the Contracting Party shall ensure that all reasonably practicable improvements are made as a matter of urgency to upgrade the safety of the nuclear installation. If such upgrading cannot be achieved, plans should be implemented to shut down the nuclear installation as soon as practically possible. The timing of the shut-down may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact.

This chapter gives the information requested by Article 6 of the Convention. It contains:
- a list of existing installations, as defined in Article 2 of the Convention;
- an overview of safety assessments which have been performed, plus their main results;
- an overview of programmes and measures for upgrading the safety of nuclear installations, where necessary, and/or the timing of shut-downs; and
- a description of the position of the Netherlands with respect to the further operation of the installations, based on a review of safety at the time when the Convention entered into force (i.e. 13 January 1997), plus details of the situation in the Netherlands regarding safety issues since the last review in 2011.

6.1 Existing installations

The Netherlands has one nuclear power plant in operation: the Borssele NPP (a PWR, Siemens/KWU design). There also is one shut-down plant which already is at an advanced stage of decommissioning (safe enclosure): the Dodewaard NPP (a BWR, GE design, 60 MW_e). In addition there are three research reactors, the largest of which has a thermal power of 45 MW, the High Flux Reactor (HFR) in Petten. One of these research reactors, the smallest one, the LFR[21], has been permanently taken out of operation and its decommissioning is being prepared. The HOR research reactor in Delft is planned to be upgraded with extra facilities.

6.1.a Borssele NPP

The Borssele NPP is a two-loop Siemens PWR that has been in commercial operation since 1973. As it is the only NPP now in operation in the Netherlands, the emphasis in the remainder of this report is on this plant. It started with an electrical power of 450 MW_e but a turbine upgrade in 2006 has boosted its net electrical output to about 485 MW_e. The NPP generates some 4% of the Netherlands'electricity demand.

In 1994 Dutch Parliament decided to phase out the plant by 2003. The decision was legally challenged and taken back. Instead, in 2006 a Covenant was signed by operator and owners of the plant and the government, allowing the plant to operate until end 2033 at the latest, under certain conditions.

[21] This is the Low Flux Reactor (LFR), an Argonaut-type reactor with a maximum thermal power of 30kW. It is operated by its Licence Holder, the Nuclear Research & consultancy Group (NRG) in Petten.

The operator and Licence Holder (LH) of Borssele NPP is the company EPZ. Delta and Essent/RWE are shareholders op EPZ, and own 70% respectively 30% of the shares.

Technical details of the Borssele NPP are provided by Appendix 5.

6.1.b Dodewaard NPP

The Dodewaard NPP was a BWR-type 60 MW_e reactor that operated from 1968 until early 1997. The plant was used for R&D purposes for the utilities and for maintaining nuclear expertise for possible expansion of nuclear power in the Netherlands. On 3 October 1996, the owners of the Dodewaard NPP (SEP: a former alliance of Dutch utilities) decided to shut down the reactor permanently[22], because of lack of support for a nuclear programme. The shutdown became effective on 26 March 1997.

In 2002 the LH obtained a licence for 'deferred dismantling' after 40 years of safe enclosure.

In April 2003, all the spent fuel had been removed from the site and had been shipped to Sellafield. April 2005, the construction of the 'safe enclosure' was finished. June 1st, 2005, the 40-years waiting period started under a licence that requires the owner to commence dismantling activities in 2045. The current owner of the Dodewaard NPP (GKN) has no other activities than to maintain the safe enclosure during the waiting period. In 2009, all vitrified waste from reprocessing of Dodewaard's spent fuel was shipped to the national waste management authority, COVRA.

6.1.c Research Reactors: High Flux Reactor (HFR)

Although research reactors formally are not subject to the Convention, in this report information is included about the High Flux Reactor (HFR), a relatively 'large' 45 MW_{th} research reactor.

The HFR is a tank-in-pool type reactor commissioned in 1961 and is located in Petten in the province of North Holland. The owner is the Joint Research Centre (JRC) of the European Commission but since January 2005, the LH and operating organisation is the Nuclear Research and consultancy Group (NRG). The HFR is used not only as a neutron source for applied and scientific research, but also for the production of isotopes for medical and industrial applications.

6.1.d Research Reactors: HOR in Delft

The HOR is an open pool-type research reactor with a thermal power of 2 MW_{th}. It is located in Delft. The owner is the Technical University of Delft. It services education and research purposes. Medical applications are getting more and more attention at the HOR[23] and its associated facilities.

6.1.e Plans for new Nuclear Power Plants

In 2009 plans were revealed by the company Delta N.V. for nuclear new build at the site of the NPP Borssele. Delta currently is the majority (70%) shareholder in the current NPP but also generates power using coal, biomass, natural gas and wind.

Early 2012 Delta announced to shelve its plans for a few years, considering the current unfavourable economic environment and the uncertainties it introduced.

In parallel to Delta, company ERH (Energy Resources Holding) also developed plans for new nuclear power in the Netherlands. These were shelved as well for similar reasons.

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[22] The reason for the shut down decision was the lack of support for a nuclear program and the fact that the plant was too small to compete on the liberalised electricity market if its research function was to become obsolete.
[23] Dutch: 'Hoger Onderwijs Reactor' (HOR), i.e. 'Higher Education Reactor'

6.1.f Plans for new Research Reactor: PALLAS

A new research reactor (named PALLAS) is under consideration in order to replace the HFR. Plans for PALLAS were initiated by company NRG, current LH and operator of the HFR. A foundation is being established that will conduct all preparatory activities required for the realisation of the new reactor. The national government and the province of North Holland together provided a loan of about 80 Meuro to finalize licensing and design of PALLAS. An important precondition for support is the realisation of a sound business plan and the acquisition of (private) funding for the constrtuction and operation of PALLAS.

6.1.g Plans for upgrading of Research Reactor HOR: OYSTER

OYSTER (Optimized Yield for Science, Technology & Education, of Radiation) is the project that will make the applicablity of the research reactor, the HOR of the Technical University in Delft (‘TU Delft’) and the associated neutron scattering equipment much wider, and provide its users with more precise results in a shorter time.

The installation of a liquid hydrogen cold neutron source is an essential element in the project. The reactor core is not to be compacted but still its power will be increased from 2 to 3 MW. The availability of cold neutrons will result in new, more interesting applicability for most of the existing neutron instruments. At the same time, the positron source will increase significantly in brightness.

The project will be contracted in a European competitive dialog procedure (complying with Directive 2004/18/EC). The project is jointly financed by the University and the national government.

The upgrade will require a new licence. The LH will have to submit among others a Safey Analysis Report (SAR) and an Environmental Impact Assessment (EIA) report.

6.2 Overview of safety assessments and other evaluations

6.2.a Borssele NPP

For assessment and verification of safety of the NPP, also refer to the text on Article 14. In that section more complete information on recent Periodic Safety Reviews and post-stress test Actions is given. Also reference is made to Part II of the Summary, featuring a table with all post-stress test Actions on the part of the LH (i.e. EPZ).

The licence for the Borssele NPP does not have an end date. However, in June 2006 the government and the owners of the plant signed an agreement, the Borssele Covenant, allowing the plant to operate until end 2033 at the latest, under a number of extra conditions (in addition to the licence conditions). Details about the Covenant can be found in Appendix 6. Results of the review by the so-called Benchmark commission can be found in the text on Article 14 and in Appendix 6.

Several PSRs have been completed at the Borssele NPP, each has been followed by implementation of improvements. The descriptions under Article 14 and Appendix 5 provide details of the special focuses of these reviews and of the improvements associated with these.

Since the drafting of previous report to the CNS, the following issues require(d) attention of the Regulatory Body (RB):

- In 2009, the management of the plant started the licence application for the use of mixed oxide fuel (MOX). An environmental impact assessment report was drafted and was submitted for evaluation in the autumn of 2010. The licence for loading MOX fuel became irrevocable in February 2013.
- Operation of the plant beyond 2013 requires an adequate Long Term Operation (LTO) programme giving attention to among others ageing issues. The RB assessed in 2012 the LTO programme of

the LH and concluded it was adequate. The RB received support from a foreign TSO, and in addition could benefit from the findings of the 2012 SALTO mission to the Borssele NPP;

- The third 10-yearly Periodic Safety Review, PSR, (Dutch: '10-EVA') is ongoing, requiring resources at the NPP and the RB. A number of PSR actions have also been included in the list of post-Fukushima Daiichi Actions and these will be handled in the PSR process;
- In 2011 the LH of the Borssele NPP submitted its 'Licensee Report' to the RB, reporting on the Complementary Safety Assessment ('stress test') of its facility, drafted along the guidelines provided by ENSREG. Review by the RB confirmed that the plant complies with the requirements of its licence base and that there are safety margins past these requirements. In line with the purpose of the ENSREG-led European 'stress test', options to improve safety even further were identified by the LH. In addition the RB identified additional improvement options, which the LH needed to implement.
- The RB end of 2011 submitted its National Report on the stress test to ENSREG for European peer review. May 2012 the RB published a National Report to the 2nd Convention on Nuclear Safety (CNS) Extraordinary Meeting, reporting on the same post-Fukushima Daiichi Actions as in the report of 2011, but in the CNS-prescribed format. This report was subject to peer review in August 2012. In December 2012 the RB published its National Action Plan (NAcP) for the followup of post-Fukushima Daiichi related activities, including those that needed to be implemented by the LH, and those to be implemented by the RB. The NAcP provides the most comprehensive survey of all required Actions to date. It was subject to review in the ENSREG-led NAcP Peer Review Workshop in April 2013. More information on all scheduled Actions can be found in the text on Article 14 and in the also in the Summary.
- In the summer of 2012, during a new type of in-service inspection conducted for the first time in neigbouring country Belgium, flaw indications were detected in the base metal of the Doel 3 and Tihance 2 reactor pressure vessels (RPVs). Checks carried out in the Netherlands in Borssele NPP, showed that the Borssele RPV does not present defects corresponding to those found in Belgium.
- The management of the plant is considering introducing digital I&C into the plant. Careful considering must be given to the associated reliability and safety issues. The preparation of the introduction of digital control of the Reactor Control and Limiting System is ongoing.;
- Operation of the Borssele plant for 60 years has consequences for the required storage capacity at the COVRA interim radioactive waste storage facility. Vitrified waste from reprocessing of spent fuel of the NPP (and spent fuel of research reactors) is stored in the dedicated HABOG building on the COVRA site, together with non-reprocessed spent fuel of research reactors. The capacity of the modular-design bunker-like building with 1.7 meter thick reinforced concrete walls, will be extended. Currently the associated environmental impact assessment is ongoing.
- An important issue for the management of the NPP is the maintenance of number and quality of its staff. In 2011, operator EPZ employed 55 extra staff to strengthen its organisation. Improvement of communication and organisation of working flows get proper attention. The measures serve to further reduce the number of incidents.

6.2.b HFR RR

At the past review meetings, several Contracting Parties showed an interest in this research reactor and the particular issues surrounding it. For some technical details and past issues of the HFR refer to Appendix 7 of the present CNS report.

In August 2008 a routine in-service inspection detected jets of gas bubbles in one of the reducers that is part of the primary cooling system. Repair was undertaken, which was concluded in 2010, after which operation was resumed.

End of 2012 there was a new issue with the cooling system, detected during a regular reactor stop. There was an anomaly detected in the interface between the pool cooling system and the primary

cooling system. There were no off-site safety risks, but the LH, (i.e. company the NRG) decided not to start the reactor at the end of the stop. Plans of the LH for the repair and system modifications were assessed and approved by the inspectorate of the RB. In June 2013 the HFR returned to service.

6.2.c Challenges from plans for new-build, upgrading and other activities of LHs

The RB currently has adequate resources to perform its tasks. In the future the RB may be faced with challenges in terms of assuring sufficient resources. This is due to activities like the current new build initiative (PALLAS project), repair projects at the HFR, upgrade of the research reactor HOR (OYSTER project) and the various projects at Borssele NPP (post-Fukushima actions, digital I&C, followup of LTO programme). In addition there are activities at the RB in preparation of the IRRS mission to the Netherlands in 2014. More information on staffing of the RB can be found in the descriptions under Article 8 ‘Regulatory Body’, and Article 11 ‘Financial and human resources’.

CHAPTER 2(B) LEGISLATION AND REGULATION

ARTICLE 7. LEGISLATIVE AND REGULATORY FRAMEWORK

7.1 Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.

7.2 The legislative and regulatory framework shall provide for:

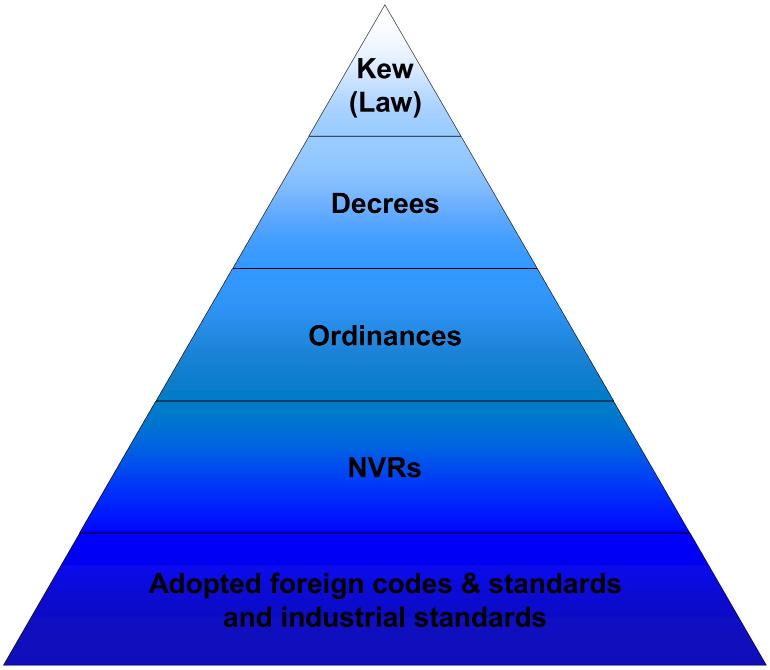
- **i. the establishment of applicable national safety requirements and regulations;**
- **ii. a system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence;**
- **iii. a system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licences.**

7.1 Legislative and regulatory framework

7.1.a Overview of the legal framework

Structure

The legal framework in the Netherlands with respect to nuclear installations can be presented as a hierarchical structure. Refer to the diagram in Figure 1.



The Nuclear Energy Act (Kew) is the most prominent law. (section 7.1.b)

Decrees containing additional regulation (section 7.2. (i)).

Ordinances containing additional regulation (section 7.2. (i))

NVRs, safety requirements issued by the Regulatory Body and referenced in the licences of nuclear installations (section 7.2. (i))

Various industrial codes and standards part of the licensing base (section 7.2. (i))

Figure 1 Simplified representation of the hierarchy of the legal framework

In addition to the levels shown in Figure 1, there are international conventions and other legal instruments related to nuclear safety that also apply. Refer to section 7.1.c for more information.

The minister of Economic Affairs (EZ[24]) is the principal responsible authority for conducting the regulatory process under the Nuclear Energy Act and for the main functions of the Regulatory Body (RB). Refer to the text on Article 8 for more information on the RB.

Several other ministers also have responsibilities in specific areas related to the use of radioactivity and radiation. The ministry of EZ is the coordinating ministry for all the issues related to the Nuclear Energy Act. The following list illustrates the responsibilities of the various ministers regarding the various areas of interest:

- Minister of Economic Affairs (EZ) for nuclear safety, radiation protection, physical protection of fissile materials and radioactive materials and wastes. Also coordinating minister for the Act; i.e. minister reporting to Parliament and responsible for the 'maintenance' of the Act. The coordination function has been recorded in a special Decree.
- Minister of Economic Affairs (EZ) for radiation protection in the mining industry.
- Minister of Social Affairs and Employment (SZW) for worker safety and health.
- Minister of Health, Welfare and Sports (VWS) for healthcare and patient safety.
- Minister of Infrastructure and the Environment (I&M) for emissions into surface water.
- Minister of Security and Justice cooperating in the execution of the National Nuclear Emergency Management and Response Plan (NPK).
- Minister of Defence for military applications of ionizing radiation.
- Minister of Finance for insurance and other issues of liability.
- Minister of Foreign Affairs for the coordination of Dutch foreign policy, regarding to the Nuclear Energy Act especially focused on non proliferation and Euratom and IAEA affairs.

7.1.b Primary legislative framework: laws

The following are the main laws to which nuclear installations in the Netherlands are subject:

- The Nuclear Energy Act ('Kernenergiewet', Kew);
- The Environmental Protection Act ('Wet milieubeheer', Wm);
- The General Administrative Act ('Algemene wet bestuursrecht', Awb), regulating the procedures under of laws.
- The Act on Liability for Nuclear Accidents ('Wet Aansprakelijkheid Kernongevallen', WAKO);
- The Water Act ('Waterwet, Ww);
- Environmental Permitting Act ('Wet algemene bepalingen omgevingsrecht', Wabo).

Other important Acts with relevance for the licencing and operation of nuclear installations are the Act on Government Information ('Wet Openbaarheid van Bestuur', WOB) and the Dutch Safety Regions Act (Wet veiligheidsregio's). In this section, the main elements of the several acts are elaborated. For more information on secondary legislation, like the aforementioned Decrees and NVRs, refer to section 7.2. (i).

Nuclear Energy Act

The basic legislation governing nuclear activities is contained in the Nuclear Energy Act ('Kernenergiewet' or Kew). It is a framework law, which sets out the basic rules on the application of nuclear technology and materials, makes provision for radiation protection, designates the competent

[24] Dutch: EZ, 'Economische Zaken' (i.e. Economic Affairs).

authorities and outlines their responsibilities. More detailed legislation is provided by associated Decrees.

The Nuclear Energy Act originally had a twofold purpose: (1) to regulate the use of nuclear energy and radioactive techniques, and (2) to lay down rules for the protection of the public and workers against the associated risks. In practice, however, the law has developed almost entirely to do the latter.

With regard to nuclear energy, the purpose of the Nuclear Energy Act, according to its Article 15b, is to serve the following interests:

- the protection of people, animals, plants and property;
- the security of the state;
- the security and safeguarding of nuclear material;
- the supply of energy;
- the liability for damage or injury caused to third parties;
- the compliance with international obligations.

Within the framework of the Nuclear Energy Act, fissionable materials are defined as materials containing up to a certain percentage of uranium, plutonium or thorium (i.e. 0.1% uranium or plutonium and 3% thorium by weight) and used for the purpose of fission and/or breeding. All other materials containing radionuclides and exceeding the exemption levels, are defined as radioactive materials.

Three areas of application

As far as nuclear facilities are concerned, the Nuclear Energy Act covers three distinct areas relating to the handling of fissionable materials and ores: (1) registration, (2) transport and management of such materials, and (3) the operation of facilities and sites at which these materials are stored, used or processed:

(1) The *registration* of fissionable materials and ores is regulated in Sections 13 and 14 of the Nuclear Energy Act; further details are given in a special Decree issued on 8 October 1969 (Bulletin of Acts and Decrees 471). The statutory rules include a reporting requirement under which notice must be given of the presence of stocks of fissionable materials and ores. The Central Import and Export Office, part of the Tax and Customs Administration of the Ministry of Finance, is responsible for maintaining the register.

(2) A licence is required in order to *transport*, *import, export*, be in *possession* of or *dispose* of fissionable materials and ores. This is specified in Section 15a of the Act. The licensing requirements apply to each specific activity mentioned here.

(3) Licence Holders (LHs) are also required for *building, operating and decommissioning* nuclear installations (Section 15b), as well as for nuclear driven ships (Section 15c). To date, the latter category has not been of any practical significance in the Netherlands.

Under item (3), the Nuclear Energy Act distinguishes between construction licences and operating licences. In theory, a licence to build a nuclear installation may be issued separately from a licence to actually operate it. However, the construction of a NPP involves much more than simply construction work. Account will be taken of all activities to be conducted in the plant, during and after its construction. The authorities need to decide whether the location, design and construction of the plant are suitable, offering sufficient protection of the public and the environment from any danger, damage or nuisance associated with the activities to be conducted in the plant.

In practice, the procedure for issuing a licence to operate a NPP or other nuclear facility will be of limited scope, unless major differences have arisen between the beginning and the completion of the

construction work. For example, there may be a considerable difference between the Preliminary Safety Analysis Report (which provides the basis for the construction licence) and the Final Safety Analysis Report (for the operating licence). Views on matters of environmental protection may also have changed over the construction period.

Modifications of licenced plants
Amendments to a licence will be needed where modifications of a plant invalidate the earlier description of it.

The decommissioning of nuclear facilities is regarded as a special form of modification and is treated in a similar way. Refer to section 7.2. (i) for the Bkse decree, that provides more guidance on decommissioning issues.

For minor modifications, a special notification procedure in the Act applies, allowing the LH to modify the facility without a formal amendment to the licence. This notification system can be used only if the consequences of the modification for man and environment are within the limits of the licence.

In addition to the secondary regulations provided by the aforementioned Bkse-decree on the handling of fissionable materials, the Nuclear Energy Act includes a separate chapter (Chapter VI) on intervention and emergency planning and response.

Recent amendments to the Act
The Nuclear Energy Act (Kernenergiewet, Kew) has been amendedseveral times.

The amendment in 2008 concerned the ratification and implementation of the Convention on physical protection of nuclear materials and nuclear facilities, and also introduced some requirements on nuclear security.

An other amendment was adopted in 2009 and introduced three important modifications:

- Introduction of the obligation for the LH to provide financial provisions for the costs of decommissioning of his installation. This requirement entered into force in 2011.
- Introduction of the possibility for the competent authority, the RB, to withdraw the licence of a nuclear facility after its decommissioning is completed.
- Reduction of the number of ministries involved in licensing nuclear facilities under the Nuclear Energy Act to one. This change took effect in 2011, resulting in the minster of Economic Affairs (EZ) becoming the principal authority for conducting the regulatory process under the Nuclear Energy Act and for the main functions of the Regulatory Body (RB). Before, this authority was shared by six ministries, although the procedures were coordinated by one ministry.

Evaluation and revision of the Nuclear Energy Act
The Nuclear Energy Act has been evaluated in the context of the associated legal and regulatory framework on nuclear safety and radiation protection. It has been decided to have a major update of this Act and some other elements in the hierarchy of the legal framework. The comprehensive revision of the regulatory framework is underway.

Environmental Protection Act (Wm)
In the case of non-nuclear facilities, this Act regulates all environmental issues (e.g. chemical substances, smell and noise); in the case of nuclear installations, the Nuclear Energy Act takes precedence and regulates both conventional and non-conventional environmental issues.

According to this Act and the associated Environmental Impact Assessment Decree, the licensing procedure for the construction of a nuclear facility includes a requirement to draft an Environmental

Impact Assessment (EIA) report. In certain circumstances, an EIA is also required if an existing plant is modified. More specifically, it is required in situations involving:

- a change in the type, quantity or enrichment of the fuel used;
- an increase in the release of radioactive effluents;
- an increase in the on-site storage of spent fuel;
- decommissioning;
- any change in the conceptual safety design of the plant that is not covered by the description of the design in the safety analysis report.

The Environmental Protection Act states that under certain conditions, an independent Commission for Environmental Assessments must be established and in these cases it should be consulted when it is decided that an EIA needs to be submitted. For this purpose, there exists a dedicated organisation, named 'Commissie voor de m.e.r.'. On the level of the Decree, the types of activities for which such assessments are required are specified.

The general public and interest groups often use EIAs as a basis for commenting on and raising objections to decisions on nuclear activities. This demonstrates the value of such documents in facilitating public involvement.

General Administrative Act (Awb)

The General Administrative Act sets out the procedure for obtaining a licence and describes the participation of the general public in this procedure (i.e. objections and appeals). It also details the general procedures for the oversight and the enforcement, and related to the latter the possible sanctions. This law applies to virtually all procedures under any law.

Notice must be given, both in the Government Gazette and in the national and local press, of the publication of the draft decision to award a licence. At the same time, copies of the draft decision and of the documents submitted by the applicant must be made available for inspection by the general public. All members of the public are free to lodge written opinions on the draft decision and to ask for a hearing.

All objections made to the draft version of the decision are taken into account in the final version. Anybody who has objected to the draft decision is free to appeal to the Council of State (the highest administrative court in the Netherlands) against the decision by which the licence is eventually granted, amended or withdrawn.

Act on the liability for nuclear accidents ('Wet Aansprakelijkheid Kernongevallen', WAKO

In order to apply the Paris convention on nuclear third party liability and Brussels supplementary convention, the Dutch act on the liability for nuclear accidents implements the parts of these conventions, for which more detailed rules of the contracting parties are necessary. It concerns for instance:

- The maximum amount for which operators of nuclear installations are liable;
- A specification of the kind of financial security which is required.

Some options which the convention leaves to the contracting parties are adopted in the act. For instance:

- The possibility to establish a lower liability for nuclear installations of a low risk nature.
- The possibility to extend the liability to damage caused by a nuclear incident due to a grave natural disaster of an exceptional character.

The act also contains some provisions which offer extra financial protection for the public, apart from the safeguards already offered by the conventions. The most important of these provisions is the state guarantee up to €2,3 billion and a possibility to charge a fee on installations for this guarantee.

A development is the increase of the maximum liability of operators of nuclear installations from €340 million to €1.2 billion (effective since 1st of January 2013). The ministry of Finance intends to increase this maximum liability proportional to the maximum damage that the Insurance Pool in the Netherlands can cover. This would reduce the risk of the State guarantee even further.

Water Act ('Waterwet', Ww)

The purpose of the Act is to prevent and where necessary, limit flooding, swamping and water shortage. Furthermore it is meant to protect and improve the chemical and ecological status of water systems and to allow water systems to fulfil societal functions. Nuclear installations need a permit under the water act to licence their (non-radioactive) discharges to the surface water.

Environmental Permitting (General Provisions) Act (Wabo)

Some 25 existing systems for issuing permits, licences, exemptions and so on for location bound activities which have an impact on our physical environment, have been replaced (October 2010) by a single environmental licence. The main purpose is to establish a single, straightforward procedure with one set of rules for persons or businesses seeking permission for activities which affect the physical environment. This includes one application form to fill in, one single competent authority, one supervision and enforcement authority and one procedure for objections and appeals. The goal is to simplify licensing systems and reduction of expenses for the applicants.

The civil engineering part of the construction of a nuclear installation and local spatial planning aspects will be licenced under the Wabo by local authorities on the level of towns or rural municipalities. The nuclear safety and radiation protection aspects will be licenced under the Nuclear Energy Act by the national Regulatory Body.

Dutch Safety Region Act ('Wet veiligheidsregio's', Wvr)

The Safety Regions Act seeks to achieve an efficient and high-quality organisation of the fire services, medical assistance and crisis management under one regional management board. The Act stipulates that as a common rule, security regions must be structured on the same scale as the police regions. This is in no way a break in trend with practices existing before. Past regulations and legislation already required the municipalities to form regions and the Disasters and Major Accidents Act (Wet rampen en zware ongevallen - Wrzo) assumed that such regions had been established. The Safety Regions Act is thus continuing on the basis of existing structures.

Act on Government Information ('Wet Openbaarheid van Bestuur', WOB)

Under the Dutch Government Information (Public Access) Act, any person can request information related to an administrative matter as contained in documents held by public authorities or companies carrying out work for a public authority. As a basic principle, information held by public authorities is public, excluding information covered by the exceptions enumerated in the Act.

7.1.c Ratification of international conventions and legal instruments related to nuclear safety

In addition to the CNS, the Netherlands is party to many other Treaties and Conventions related to the use of nuclear technology and materials.

An important one is the 'Treaty on the Non-Proliferation of Nuclear Weapons' (NPT). Related are guidelines of the Nuclear Suppliers Group that prescribe limitations to the transfer of sensitive nuclear technologies like the enrichment and the reprocessing technologies. In addition, the Netherlands has

joined the 'Proliferation Security Initiative' (PSI), which is based on a UN Security Council Resolution 1540 (UNSCR 1540) for the non-proliferation of Weapons of Mass Destruction (WMD).

The Netherlands is also party to several Conventions on liability, like the 'Paris Convention on Third Party Liability in the Field of Nuclear Energy' and the 'Brussels Convention' supplementary to the 'Paris Convention', and the 'Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention'.

Other important Conventions are the 'Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management', and the 'Convention on Physical Protection of Nuclear Material and Nuclear Installations'.

The Netherlands has brought Council Directive 2009/71/EURATOM of 25 June 2009 on nuclear safety into force[25] in 2011.. The safety objectives of the Directive cover those of the Nuclear Safety Convention and are in some regards more specific and have a larger scope.

The Directive 2009/71/EURATOM prescribes the systematic evaluation and investigation of the nuclear safety of nuclear installations during their operating life possibly leading to changes in the installation ('continuous improvement'). Also, the regulation prescribes inter alia that:

- LHs should give sufficient priority to nuclear safety systems;
- LHs must provide adequate human and financial resources to meet the obligations on the nuclear safety of a nuclear installation;
- All parties, including the LH, are required to provide a mechanism for educating and training their staff responsible for the safety of nuclear plants to meet the expertise and competence in the field of nuclear safety to be maintained and developed.

The Netherlands is in the process of implementing Council Directive 2011/70/EURATOM of 19 July 2011 'establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste'. The Netherlands is drafting the required 'National Programme' according to the definition provided by this Directive. This is out of the scope of the present report to the CNS. Progress on implementation of this Directive will be reported in future national reports for the 'Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management'.

7.1.d Special national agreements: the 2006 Covenant

The Dutch government in 2006 signed an agreement (Covenant) with the owners of the Borssele NPP, which allows for operation until the end of 2033, if next to the requirements of the operating licence additional requirements specified in the Covenant keep being met. The legal status of the agreement is such, that it can not easily be challenged by future policies on nuclear power. T One requirement is that the Borssele NPP keeps belonging to the top-25% in safety of the fleet of water-cooled and water-moderated reactors in the European Union, Canada and the USA. To assess whether Borssele NPP meets this requirement, the Borssele Benchmark Committee (BBC) has been established.

Also refer to the text on Article 14 Appendix 6 for more information on the Covenant and a short discussion on the tasks of the 'Borssele Benchmark Commission' and its recent activities.

[25] Regulation of the Minister of Economic Affairs, Agriculture (EL&I) and Innovation and the Minister of Social Affairs and Labour of 18 July 2011, No WJZ/11014550, concerning the implementation of Directive No 2009/71/Euratom of the Council of the European Union 25 June 2009 establishing a Community framework for nuclear safety of nuclear installations (PB EU L 172/18). In 2011, implementation was done via a temporary ordinance (Stcrt. 2011, nr.12517), which was made permanent in 2013 (Stcrt. 2013, nr. 14320).

7.2 Provisions in the legislative and regulatory framework

7.2. (i) National safety requirements and regulations

This section describes the regulatory framework, that is sitting below the top-level (laws) of the legal hierarchy. Refer to section 7.1.a for the complete overview of the framework. In short there are the following categories:

- Decrees ('Besluiten');
- Ordinances ('Ministeriële regelingen');
- Dutch Safety Requirements, ('Nucleaire Veiligheidsregels', NVRs)
- Codes and Standards of industry and NPP Operators.

For each category, first the current situation is described, after which recent and planned developments are addressed.

Decrees ('Besluiten')

Decrees are empowered by Parliament and the Dutch Council of State[26] (Dutch: 'Raad van State'). A number of Decrees[27] have been issued containing additional regulations and these continue to be updated in the light of ongoing developments. Important examples of these in relation to the safety aspects of nuclear installations are:

- the Nuclear Installations, Fissionable Materials and Ores Decree (Bkse);
- the Radiation Protection Decree (Bs);
- the Transport of Fissionable Materials, Ores and Radioactive Substances Decree (Bvser);
- the Environmental Impact Assessment Decree.

The Nuclear Installations, Fissionable Materials and Ores Decree (Bkse) regulates all practices involving fissionable materials and nuclear facilities (including licensing). The Radiation Protection Decree (Bs) regulates the protection of the public (including patients) and workers against the hazards of all ionising radiation. It also establishes a licensing system for the use of radioactive materials and radiation-emitting devices, and prescribes general rules for their application. The Transport of Fissionable Materials, Ores and Radioactive Substances Decree (Bvser) deals with the import, export and domestic transport of fissionable materials, ores and radioactive substances by means of a reporting and licensing system.

The Nuclear Energy Act and the aforementioned Decrees are fully in compliance with the relevant Euratom Directive laying down the basic safety standards for the protection of workers and the general public against the health risks associated with ionising radiation. This Directive (96/29/Euratom) is incorporated into the relevant Dutch regulations.

The Environmental Impact Assessment Decree, in combination with the Environmental Protection Act, stipulates that in certain circumstances a licence application for a nuclear installation shall be accompanied by an EIA. This complies with EU Council Directive 97/11/EC.

Current regulation already provides for limited reimbursement of the RB for the costs of oversight and licencing. The LHs pay an annual fee and on top of this there are fees for individual licencing activities. However, currently only a limited fraction of the annual budget of the RB is collected. The

[26] The 'Raad van State', the 'Council of State' has two primary tasks, carried out by two separate divisions. The Advisory Division, as its name implies, advises the government and Parliament on legislation and governance, while the Administrative Jurisdiction Division is the country's highest general administrative court. The basis for these responsibilities can be found in articles 73 and 75 of the Dutch Constitution.

[27] In Dutch legislation they belong to the category: 'Algemene maatregelen van bestuur'

objective is to increase this fraction in the coming years. Therefore new reimbursement regulation[28] is being drafted. The aim for the entry into force of the associated Decree is early 2014.

In the next paragraphs, some details of the various existing Decrees are addressed.

Radiation Protection Decree ('Besluit Stralingsbescherming', Bs)

The Bs and dose criteria for normal operation
The main elements of the Bs are: (1) justification of the activity, (2) optimization - ALARA and (3) dose limits.

Practices involving ionizing radiation should be justified. Dutch regulation features a list of 'justified and not justified practices'.

The exposure to ionising radiation should be kept As Low As Reasonably Achievable (ALARA). The ALARA principle is recorded in the Nuclear Energy Act (article 15 and 31 of that law), the Bs Decree and also in the Bkse Decree.

The dose limit for members of the public is a maximum total individual dose of 1 mSv and 20 mSv for workers in any given year as a consequence of normal operation from all anthropogenic sources emitting ionising radiation (i.e. NPPs, isotope laboratories, sealed sources, X-ray machines, industries, etc.).

For a single source (for instance a single NPP), the maximum individual dose is set at 0.1 mSv per annum.

Nuclear Installations, Fissionable Materials and Ores Decree ('Besluit kerninstallaties, splijtstoffen en ertsen', Bkse)

The Bkse and licensing construction, commissioning & operation
The Bkse sets out additional regulations in relation to a number of areas, including the licence application procedure for the construction, commissioning and operation of a nuclear reactor, and associated requirements. According to article 6 of Bkse, for such an application, applicants are required to submit (among others) the following information:

- a description of the site where the installation is to be located, including a statement of all relevant geographical, geological, climatological and other conditions;
- a description of the installation, including the equipment to be used in it, the mode of operation of the installation and the equipment, a list of the names of the suppliers of those components which have a bearing on the assessment of the safety aspects, and a specification of the installation's maximum thermal power;
- a statement of the chemical and physical condition, the shape, the content and the degree of enrichment of the fissionable materials which are to be used in the installation, specifying the maximum quantities of the various fissionable materials that will be present at any one time;
- a description of the way in which the applicant intends to manage the relevant fissionable materials after their use;
- a description of the measures to be taken either by or on behalf of the applicant so as to prevent harm or detriment or to reduce the risk of harm or detriment, including measures to prevent any harm or detriment caused outside the installation during normal operation, and to prevent any harm or detriment arising from the Postulated Initiating Events (PIEs) referred to in the description, as well as a radiological accident analysis concerning the harm or detriment likely to be caused outside the installation as a result of those events (safety analysis report);

[28] Dutch working title: 'Bijdragenbesluit'

- a risk analysis concerning the harm or detriment likely to be caused outside the installation as a result of severe accidents (Probabilistic Safety Analyses);

The Bkse and decommissioning
For the application for a decommissioning licence, according to Bkse, the LH shall submit the following information to the authorities:

- a copy of the operating licence;
- a decommissioning plan;
- a description of the measures to be taken either by or on behalf of the applicant so as to prevent harm or detriment or to reduce the risk of harm or detriment, including measures to prevent any harm or detriment caused outside the facility during normal operation, and to prevent any harm or detriment arising from the Postulated Initiating Events (PIEs) referred to in the description, as well as a radiological accident analysis concerning the harm or detriment likely to be caused outside the installation as a result of those events (Safety Analysis Report);
- a risk analysis concerning the harm or detriment likely to be caused outside the installation as a result of severe accidents.

In April 2011, Bkse was amended, introducing new legislation on decommissioning and financial provisions for the costs of decommissioning. An important part of this legislation was based on the WENRA[29] Safety Reference Levels on decommissioning.

The new legislation requires the LH to have and periodically (every five years) update a decommissioning plan during the lifetime of the facility. The plan shall be approved by the authorities every time it is updated. In addition to this, minimum-requirements on the content of a decommissioning plan are defined. The decommissioning plan serves as the safety-basis for all the activities carried during the decommissioning phase, and it provides the basis for the financial provisions for the decommissioning costs. During decommissioning, the LH is obliged to act according to the decommissioning plan.

Furthermore, the LH is required to have a financial provision to cover the costs of decommissioning, which will have to be updated and approved by the authorities every time the decommissioning plan is updated. The LH is in principle free to choose the form of the financial provision. Upon approval, the authorities will assess whether the financial provision offers sufficient security that the decommissioning costs are covered at the moment of decommissioning.

The Bkse and the Community framework for nuclear safety
Council Directive 2009/71/Euratom establishes a (European) Community framework for nuclear safety of nuclear installations. It has been implemented in Dutch regulation and as such has had its impact on the Bkse-decree. The safety objectives of this (European) Council Directive cover those of the Nuclear Safety Convention and are in some regards more specific and have a larger scope.

The Bkse and the risk criteria for incidents and accidents
The Netherlands has a policy[30] on tolerance of risks posed by any hazardous activity and including also nuclear power stations. This policy has been formulated independently of the Nuclear Safety Requirements (the ‘NVRs’) and is primarily incorporated in the Bkse Decree.

The basis and application of the regulations are discussed in some detail in Appendix 1, which includes more detailed references to official documents (Acts, Decrees, etc.). As far as the radiological hazard is concerned, the regulations can be seen as implementing the IAEA Fundamental Safety

[29] Western European Safety Regulators Association, WENRA.
[30] Formulated by the former ministry of VROM

Standards (IAEA SF-1), in particular implementing the primary 'Safety Objective': '*The fundamental safety objective is to protect people and the environment'*.

The application according to Bkse of this objective requires the LH to:

- verify that pre-set criteria and objectives for individual and societal risk have been met. This includes identifying, quantifying and assessing the risk;
- reduce the risk, if required, until an optimum level is reached (based on the ALARA principle);
- exercise control, i.e. maintain the level of risk at this optimum level.

Bkse and Risk criteria (1): Individual risk
In accordance with the probabilistic acceptance criteria for individual mortality risk as laid down in Bkse, the maximum permissible level for the individual mortality risk (i.e. acute and/or late death) has been set at 10^{-5} per annum for all sources together and 10^{-6} per annum for any single source. These numerical criteria were developed as part of general Dutch risk management policy in the late eighties of the 20th century. Based on an average annual mortality risk of 10^{-4} per annum for the least sensitive (highest life expectancy) population group (i.e. youngsters around 12 years old from all causes, it was decided that any industrial activity should not add more than 1% to this risk. Hence, 10^{-6} per annum was selected as the maximum permissible additional risk per installation. Furthermore, it is assumed that nobody will be exposed to risk from more than 10 installations and the permissible cumulative individual mortality risk is therefore set at 10^{-5} per annum.

Bkse and Risk criteria (2): Group or societal risk
Where severe accidents are concerned, it is necessary to consider not only the individual mortality risk but also the group risk ('societal risk'). In order to avoid large-scale disruption to society, the probability of an accident in which at least 10 people suffer acute death is restricted to a level of 10^{-5} per annum. If the number of fatalities increases by a factor of n, the probability should decrease by a factor of n^2. Acute death means death within a few weeks; long-term effects are not included in the calculation of group risk.

Bkse and Risk criteria: taking account of countermeasures
In demonstrating compliance with the risk criteria, it is required to assume in the supporting analysis that only the usual forms of mitigating measures are taken (i.e. action by fire services, hospitals, etc.). Although the emergency preparedness organisation may take special measures like evacuation, iodine prophylaxis and sheltering, these are disregarded in the Probabilistic Safety Analysis (PSA). In fact it is assumed that any countermeasure will never be 100% effective. It is more realistic to expect that a substantial part of the population will be unable or unwilling to adopt the prescribed countermeasure(s). The PSA results used to demonstrate compliance with the risk criteria, therefore need to reflect this more conservative assumption[31].

See Appendix 1 for a discussion of the abovementioned dose- and risk criteria and their background.

Ordinances ('Ministeriële Regelingen, MR');

Ordinances or 'ministerial orders' are issued by the minister of Economic Affairs (EZ) and are mandatory for all nuclear installations and activities. In this section, only developments regarding ordinances are discussed.

Ordinance on the implementation of Directive nr 2009/71/EURATOM
The Netherlands has brought Council Directive 2009/71/EURATOM of 25 June 2009 on nuclear safety into force on July 22, 2011. It was implemented in Dutch regulations via an ordinance. For more information, refer to section 7.1.c.

[31] However, for the sake of interest, the PSA results of the Dutch NPP show both situations: with and without credit being given for countermeasures.

Ordinance on 'Physical protection of radioactive sources'
This new regulation entered into force at April 2013 and was introduced to strenghten the physical protection of (non-nuclear) radioactive materials in order to reduce the risk of misuse of these materials. This goal is also formulated by the IAEA Code Of Conduct and by the CBRN-Actionplan of the European Commission. The regulation is based the recommendations of "Security of Radiaoctive Sources" (IAEA Nuclear Security Series No.11). The regulation will be evaluated after two years (in 2015).

Ordinance on Physical protection of nuclear facilities and fissionable materials - update
The ministerial order on security and nuclear fuel came into force in January 2011. Based on this ordinance the nuclear facilities have adjusted their security plans. End 2013, the regulation will be adapted to the changes incorporated in revsion 5 of INFCIRC 225. It is expected that the revised regulation will be approved beginning 2014.

Ordinance on (nuclear) pressure equipment
A new ministerial order has been established on the qualification of nuclear pressure equipment. The order entered into force on 1 January 2008. The order among others defines the qualifications required for Notified Bodies to inspect pressure equipment under supervision of the RB and perform these inspections in accorance with the European Pressure Equipment Directive.

Ordinance on New Safety Requirements - developments
The ministry of EZ will develop in the near future an ordinance on safety requirements to be met by reactors. The MR will be based on the new Dutch Safety Requirements, that are being developed.

The RB is finishing the new Dutch Safety Requirements (DSRs) for water cooled and water moderated reactors. They are based on the IAEA Safety Fundamentals, several Safety Requirements guides and some Safety Guides, safety objectives published by WENRA and some other reputed sources. The DSR may become applicable to existing reactors as far as reasonably achievable and in line with the objective of continuous improvement. There is an annex to the DSR dedicated to Research Reactors (RRs). The application of this annex to existing research reactors will have a graded approach. The development of the DSR is a major effort of the RB. Assistance has been contracted from a foreign TSO.

The DSR describes a major part of the required processes and regulations for the licensing of NPPs. This will contribute to establishing a new and well structured regulatory framework.

Regulations and guides issued by Regulatory Body: the Nuclear Safety Rules (NVRs)

The Nuclear Energy Act (Article 21.1) provides the basis for a system of more detailed safety regulations concerning the design, operation and quality assurance of nuclear power plants. These are referred to as the Nuclear Safety Rules (Dutch: 'Nucleaire VeiligheidsRegels', NVRs). The regulations of the NVRs apply to an installation or nuclear facility, as far as they are referenced in their licences. This mechanism allows the Regulatory Body (RB) to enforce the NVRs. The practice of including requirements in the licence is suitable for a country like the Netherlands with a very small number of nuclear facilities and only one operating NPP.

However, the NVR based on IAEA Safety Requirements GS-R-3 'The Management System for Facilities and Activities' is by an ordinance directly applicable to the licences of all LHs.

NVRs, adapted to the use in the Dutch NPP
The NVRs are based on the Safety Standards and Guides issued by the.IAEA. Using an agreed working method, these IAEA documents have been studied to determine how they can be applied in the Netherlands. This procedure has resulted in a series of adaptations (termed 'amendments') to the IAEA documents, which then have become the draft NVRs. The amendments have been formulated for various reasons: to allow a more precise choice out of different options, to give further guidance, to

be more precise, to be more stringent, or to adapt the wordings to specific Dutch circumstances like risk of flooding, population density, seismic activity and local industrial practices.

At the Safety Standards level, the NVRs are strict requirements which must be followed in detail. At the Safety Guides level, the NVRs are less stringent: alternative methods may be used to achieve the same safety levels.

NVRs, history of their development
The first set of formally established NVRs was based on the original NUSS programme. However, in 1996 the IAEA launched a major programme to review and update the existing IAEA standards. The revised standards began to be published in the year 2000. At the time, implementation of the new standards was not considered to be particularly necessary in the Netherlands, given that the only NPP still in operation was then expected to shut down in 2003. A gradual change in politics took place leading first to moving this date to 2013 and later on to an agreement (the Covenant) allowing operation until the end of 2033 at the latest under additional preconditions. Refer to Appendix 6 about 'the Borssele Covenant'.

After these changes had taken place, the need for revision of the NVRs became obvious.

Appendix 4 contains a table of the current NVRs and related IAEA Safety Standards and Safety Guides as applicable (amended) for the purpose of the licence of the Borssele NPP.

Adopted foreign nuclear codes and standards
The Regulatory Body's experience with the IAEA-based NVRs has been generally positive, although they have not proved to be a panacea for all problems related to regulation. Strong points are the clear top-down structure of the IAEA hierarchy[32] of nuclear and radiation safety Standards and their comprehensiveness. However, given that they are the result of international cooperation, the standards cannot cover all aspects in the detail sometimes offered by some national (nuclear) regulatory systems.

To cope with this difficulty, inspectors and assessors involved with their application, need to have an adequate knowledge of the current state of technology in the various areas relevant to safety. In addition, sometimes additional material is needed to define the licensing basis. Nuclear codes and standards of other countries often are adopted. Examples are the US Code of Federal Regulations, the USNRC Regulatory Guides, the USNRC Standard Review Plan, and the RSK recommendations (German). However, careful consideration needs to be given to application of these foreign standards, since using them out of their original context may lead to difficulties.

[32] The Safety Standards Series comprises the following levels of documents: Safety Fundamentals, Safety Requirements and Safety Guides

Adopted industrial standards
The Safety Guides in the NVR series give guidance on many specific items. However, they do not cover industrial codes and standards. Applicants are therefore required to propose applicable codes and standards, to be reviewed by the Regulatory Body as part of their applications. Codes and standards in common use in major nuclear countries are generally acceptable (e.g. ASME, IEEE and KTA). The Regulatory Body has the power to formulate additional requirements if necessary.

7.2. (ii) System of licensing

As discussed in the section on Article 7.1 of the Convention, the Nuclear Energy Act stipulates (in Article 15, sub b) that a licence must be obtained to construct, commission, operate, modify or decommission a nuclear power plant. Similarly, the Act states (in Article 15, sub a) that a licence is required to import, export, possess or dispose of fissionable material.

Under Article 29 of the same Act, a licence is required in a number of cases (identified in the Radiation Protection Decree, Bs) for the preparation, transport, possession, import or disposal of radioactive material.

The procedures to obtain a licence under the Nuclear Energy Act (and other acts), follow the guidelines specified in the General Administrative Act (Awb). These procedures allow for public involvement in the licensing process. Any stakeholder is entitled to express his views regarding a proposed activity. The Regulatory Body shall take notice of all views expressed and respond to them with careful reasoning. If the reply is not satisfactory, he RB can be challenged in court.

Principal responsible authority
As already mentioned in the section on Article 7.1 the minister of Economic Affairs is the principal responsible authority for conducting the regulatory process under the Nuclear Energy Act and for the main functions of the Regulatory Body (RB).

However, in addition to the Nuclear Energy Act, several types of regulation may apply to a nuclear facility and the activities conducted in it and/or supporting it. Therefore often there are several authorities, sometimes at several levels in the governmental organisation involved in the licencing procedures.

Coordination Law
For projects related to large scale energy generation, a special Coordination Law applies. Large scale projects that could be impacted by this law are for instance the construction of power plants with an electrical power greater than 500 MW_e, investment in the power grid, etc. The Coordination Law supposes involvement of the ministry of Economic Affairs (EZ). With such large projects, the ministry of EZ is assumed to be the coordinator, organising the interaction between the many authorities, each of which will perform its duties. Typical of such projects is the involvement of many levels of governmental organisations; from the ministries down to the municipal level.

Advisory bodies
The Health Council of the Netherlands (Gezondheidsraad) is an independent scientific advisory body established under the terms of the Public Health Act. Its remit is to advise the government and Parliament on the current level of knowledge with respect to public health issues and health (services) research, including radiation protection.

To date there is no standing advisory committee on nuclear safety; an advisory committee (the Reactor Safety Commission) is formed on an ad hoc basis as required. The RB at any time can install a Commission dedicated to any required issue.

With a licence application, it very often is compulsory to conduct an Environmental Impact Assessment or EIA (Dutch: milieu-effectrapportage, m.e.r.). It is compulsory for all reactors with a

thermal power higher than 1 kW. In the Netherlands has a permanentcommission, the Commission for the Environmental Assessment (‘Commissie voor de m.e.r.’, Cmer) that advises the RB on the requirements of all EIAs conducted in the Netherlands, including those related to nuclear facilities.

Notified bodies
The legal basis for oversight on nuclear pressure equipment has been transferred from the Steam Act to the Nuclear Energy Act. Consequently the prime responsibility for its enforcement is with the ministry of Economic Affairs and the nuclear inspectorate of the RB (KFD). Refer to Article 8 for details on the organisation of the RB.

Notified Bodies under the European Pressure Equipment Directive[33] can qualify as nuclear pressure equipment inspectorate, if they can demonstrate additional qualifications in design, fabrication and inspection of nuclear pressure equipment. After positive evaluation of the Notified Body by the Regulatory Body, it can be accepted by the minister of Economic Affairs. Under this new system, the LH can select an accepted Notified Body, to inspect his nuclear pressure equipment. Refer to section 7.2. (iii) for more information on Notified Bodies.

Specific licensing issues in the Nuclear Energy Act
Article 15b of the Nuclear Energy Act enumerates the interests for the protection of which a licence may be refused. These interests are listed in section 7.1.a. The licence itself lists the restrictions and conditions imposed to take account of these interests. The licence conditions may include an obligation to satisfy further requirements that may be set later by the regulatory.

In the case of very minor modifications, the LH may use a special provision in the Act (Article 17) that allows such modifications to be made with a minor licence change. The LH needs only to submit a report describing the intended modification. This instrument can only be used if the consequences of the modification for man and the environment are within the limits of the licence in force. The notification is published and is open to appeal.

The Regulatory Body conducts regular reviews to establish whether the restrictions and conditions under which a licence has been granted are still sufficient to protect workers, the public and the environment, taking account of any developments in nuclear safety that have occurred in the meantime. Should a review indicate that, given the developments, the level of protection can and should be improved; the RB is empowered by the Nuclear Energy Act to amend the restrictions and conditions accordingly. These amendments are made by the licencing branche of the RB. It should be noted that the regular reviews are not the same as the Periodic Safety Reviews (PSRs), which the LH is required to perform periodically.

7.2. (iii) Regulatory assessment and inspections

Entities performing assessments and inspection
Article 58 of the Nuclear Energy Act states that the responsible minister should entrust designated officials with the task of performing supervision: safety assessment, inspection and enforcement. This is mainly the task of the inspectorate of the RB (KFD) in the Netherlands.

Refer to section 8.1.b for a detailed description of the RB and its entities and the working agreements governing their functioning, as well as recent developments.

There is no specific RB for the assessment and inspection of the integrity of pressure retaining components. Companies having the required knowledge and expertise, can qualify as a Notified Body. For developments regarding regulation and inspection of pressurized equipment, refer to the end of section 7.2. (i).

[33] Directive 97/23/EC of the European Parliament and of the Council of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment

Regulatory assessment process
The RB reviews and assesses the documentation submitted by the applicant. This might be the Environmental Impact Assessment (EIA) report and the Safety Analysis Report (SAR) with underlying safety analyses submitted in the context of a licence renewal application or modification request, proposals for design changes, procedural changes such as the introduction of Severe Accident Management Guidelines (SAMGs), etcetera.

There are proposed changes that are within the boundary of the licence, like requests for minor modifications and changes to the Technical Specifications. The assessments of these are carried out by the KFD and have no need of a licence modification.

During the licensing phase the RB assesses among others, whether the applicable NVRs (i.e. requirements and guidelines for nuclear safety and environment), the requirements and guidelines for security and the regulation for non-nuclear environmental protection have been met and whether the assessments (methods and input data) have been prepared according to the state of the art. The licensing branch of the RB assesses the radiological consequences associated with postulated transients and accidents in the various plant categories. The RB will verify in particular if the results are permissible in view of the regulations. The expertise of the inspectorate branch of the RB enables the RB to determine the validity of the (system) analyses and the calculations. The RB receives support from a foreign TSO in these activities.

The RB lays down the guidelines for the required calculations (data for food consumption, dispersion, etc). Acceptance criteria used in the assessments are specified in Appendix 1. Further details of the assessment process are given in the section on Article 14.

In the final stage of the licencing procedure, the inspectorate of the RB (the KFD) is asked to verify the draft licence including its licence conditions and requirements regarding its appropriateness for enforcement.

Regulatory inspections
The function of regulatory inspections mainly is:

- to check that the LH is acting in compliance with the regulations and conditions set out in the law, the licence, the safety analysis report, the Technical Specifications and any self-imposed requirements;
- to report (to the director of the inspectorate branch of the RB) any violation of the licence conditions and if necessary to initiate enforcement action;
- to check that the LH is conducting its activities in accordance with its Safety Management system;
- to check that the LH is conducting its activities in accordance with the best technical means and/or accepted industry standards;
- To check that the LH is committed to continuously improve nuclear safety.

All inspections with regard to nuclear safety, radiological protection of personnel and of the environment around nuclear sites, security and safeguards, including transportation of fresh and spent nuclear fuel and related radioactive waste to and from nuclear installations are carried out by the inspectorate branch of the RB.

The LH must act in compliance with the Nuclear Energy Act, the licence and the associated Safety Analysis Report (SAR). The compliance is verified with a system of inspections, audits, assessment of operational monthly reports, and evaluation of operational occurrences and incidents. Inspection activities are supplemented by international missions. An important piece of information for inspection is the two-yearly safety evaluation report, in which the LH presents its own assessment of

performance with respect to the licence base on technical, organisational, personnel and administrative provisions.

The management of inspections is supported by a yearly planning, the reporting of the inspections and the follow-up actions. About once or twince a year there are meetings of the management of the LH and the management of the inspectorate of the RB (KFD). The discussions are mainly about general issues relating to supervision activities. More often technical or project meetings between plant staff and inspectorate staff are held, discussing issues or progress in relation with inspection findings or assessment activities. There are also regular inspections of the plants' incident analysis group activities. Once a year a special meeting about human and organisational factors is held with a number of LHs.

Some inspections performed by the KFD are characterised by an emphasis on technical judgement and expertise. They are compliance-based, that means that the RB investigates whether the LH is acting in accordance with the terms of the licence. Other inspections focus on organisational aspects. There is a need to scrutinise the way the LH has fulfilled its responsibility for safety and to ascertain whether the LH's attitude shows a sufficient awareness of safety aspects.

Upon request of the inspectorate (KFD), in-depth international team reviews are also carried out by bodies such as the IAEA (OSART, Fire Safety, IPERS, ASSET, IPPAS and INSARR). These reviews are the results of separate decisions mainly on the initiative of KFD. RB teams carry out smaller team or team audits from time to time. In addition, the Borssele plant itself carries out self-assessments at regular intervals and invites others like WANO to perform assessments (see also section 10.2 and 14.(i)). The self-assessments have been requested by the inspectorate branche of the RB.

7.2. (iv) Enforcement

Should there be any serious shortcoming in the actual operation of a nuclear installation, the Minister of Economic Affairs is empowered under Article 37b of the Nuclear Energy Act to take all such measures as deemed necessary, including shutting down the nuclear installation. Enforcement procedures have been published describing the action to be taken if this article of the Act needs to be applied. Staff of the inspectorate (KFD) can prepare an official report for the public prosecutor, should the need occur. Other measures can be taken enforcing the conditions of the licence conditions. This is based on among others on Article 83a of the Nuclear Energy Act and on the Economic Offenses Act.

Article 19.1 of the Nuclear Energy Act empowers the Regulatory Body (RB) to modify, add or revoke restrictions and conditions in the licence in order to protect the interests on which the licence is based. Article 20a of the Act stipulates that the RB is empowered to withdraw the licence, if this is required in order to protect those interests.

Article 18a of the Nuclear Energy Act empowers the RB to compel the LH to cooperate in a process of total revision and updating of the licence. This will be necessary if, for instance, the licence has become outdated in the light of numerous technical advances or if new possibilities to even better protect the population have become available since the licence was issued.

ARTICLE 8. REGULATORY BODY

8.1 Each Contracting Party shall establish or designate a Regulatory Body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.
8.2 Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the Regulatory Body and those of any other body or organisation concerned with the promotion or utilisation of nuclear energy.

8.1.a General

The 'Regulatory Body' is the authority designated by the government as having legal authority for conducting the regulatory process, including issuing licences, and thereby regulating nuclear, radiation, radioactive waste and transport safety, nuclear security and safeguards.

The Regulatory Body is not involved in energy policies or promotion of any type of energy production.

All nuclear facilities in the Netherlands, including the NPP of Borssele, operate under licence, awarded after a safety assessment has been carried out. Licences are granted by the Regulatory Body under the Nuclear Energy Act.

In the Netherlands the minister of Economic Affairs (EZ[34]) is the principal responsible authority for conducting the regulatory process under the Nuclear Energy Act and for the main functions of the Regulatory Body.

The legal foundation of the Regulatory Body (RB) is found in several ministerial decisions detailing the mandates of the several entities that constitute the RB.

The separate entities of the RB reside in several ministries and operate with working agreements under the responsibility of the minister of Economic Affairs. The main entities are described in somewhat detail in section 8.1.b. Below their status and tasks are summarized:

- Within the ministry of EZ, the 'programmadirectie voor Nucleaire Installaties en Veiligheid' (pdNIV), i.e. Nuclear Installations and Nuclear Safety Directorate, is involved in the preparation of legislation, formulating policies (excluding energy policy), regulatory requirements and licensing.
- Within the ministry of EZ, the 'Agentschap NL', team Radiation Protection & Society[35] has been mandated to grant licences under the Nuclear Energy Act, excluding licences for nuclear installations and licences for the larger transports of nuclear fuel. Such licences are issued by the pdNIV.
- The nuclear inspectorate of the RB, the 'Kernfysische dienst' (KFD) is within the general responsibility of the Minister of EZ the responsible organisation for the independent supervision (safety assessment, inspection and enforcement) of compliance by the LH(s) with the requirements

[34] Dutch: EZ, 'Economische Zaken' (i.e. Economic Affairs)
[35] Dutch: 'Team stralingsbescherming en samenleving'

on the safety, security and non-proliferation[36]. The KFD is embedded in an organisational division of the Human Environment and Transport Inspectorate (ILT).

These entities of the RB operate under the responsibility of the minister of Economic Affairs. This minister also has political responsibility for energy policies. However the minister does not promote nuclear energy. The minister will only provide the preconditions for a reliable, affordable and safe energy supply. Within the preconditions, it is up to commercial parties to invest in nuclear power; in the liberalised energy market, the government will not invest in power plants.

8.1.b Regulatory Body – detailed information

There are several entities that together constitute the RB, overseeing nuclear safety, radiation protection, security and safeguards. The main entities are pdNIV, AgentschapNL and KFD.

The entities pdNIV, Agentschap.NL and KFD each have their own set of responsibilities and tasks, related to the Nuclear Energy Act. Nevertheless, there are many projects of the RB in which the entities work together in projecteams. Examples are the National Report for the European stress test and associated Peer Review, the National Report to the Convention on Nuclear Safety and associated activities, and the IRRS mission and its preparation.

The division of tasks is explained below.

Nuclear Installations and Nuclear Safety Directorate, pdNIV:

- Coordinates and develops the safety and environment policy of the ministry of Economic Affairs regarding nuclear issues;
- Coordinates and contributes to legislative activities and develops the regulation regarding nuclear safety, security, and safeguards in compliance with national and international laws and treaties;
- Coordinates and executes the licensing process and issues licences with an appropriate set of licensing conditions.

The pdNIV has two strategic objectives:

- Safe nuclear installations;
- Adequate protection of society in our country and abroad against risks of exposure to radiation.

These have been translated into operational objectives, among which:

- All nuclear facilities comply with state-of-the-art requirements regarding safety, security, radiation protection, waste management and environment, including lessons learnt from Fukushima Daiichi;
- Design of new nuclear facilities will also comply with abovementioned requirements;

The pdNIV is an matrix organisation, having projects and coordination fields. In these entities, the regular activities are executed.

The coordination fields are (1) Existing nuclear facilities, (2) Radiation Protection.

Major projects spanning several years are: (1) International Regulatory Review Service and the preceding self assessment, (2) National Programme Radioactive Waste, (3) Stress tests and follow-up, (4) Evaluation of regulatory framework, (5) Oyster, the upgrade of the HOR, the Delft research reactor and (6) PALLAS, the new research reactor that is to replace the High Flux Reactor (HFR) in Petten.

The pdNIV has a director and a deputy-director. In addition there are coordinators, however these are not part of the management. The pdNIV has a support staff performing secretarial and other facilitating tasks.

[36] These requirements apply to activities and facilities (including nuclear facilities).

For legal and legislative issues pdNIV cooperates with a dedicated legal department of the ministry of Economic Affairs.

Agentschap NL

Within the ministry of EZ, the 'Agentschap NL', team Radiation Protection & Society[37] has been mandated to grant licences under the Nuclear Energy Act, excluding licences for nuclear installations and licences for the larger transports of nuclear fuel. Such licences are issued by the pdNIV. The team maintains a register of compulsory notifications regarding the application of ionising radiation[38]. Furthermore the team provides information to governmental bodies and businesses.

The nuclear inspectorate, the 'Kernfysische dienst' KFD*:*

- Review and assessment of documentation submitted by LHs,
- Conducting inspections, and initiate enforcing actions when and where necessary;

The organisation consists of two departments but operates as a matrix organisation executing a programme with all activities clustered. These clusters are coordinated by a senior inspector. The current clusters are:

- Regular Supervision of Nuclear Installations and their operating organisations;
- Supervision of continuous improvement of Nuclear Installations and their operating organisations (e.g. periodic safety review);
- Supervision of Lessons-Learned Fukushima;
- Emergency Preparedness and operating experience feedback;
- Supervision of Transport of nuclear materials;
- Supervision of Security and Safeguards at nuclear installations;
- Supervision of Radiation Protection (non-nuclear) including security of radioactive sources;
- International Affairs (including IAEA missions, and IRRS);
- Preparation inspection strategy on nuclear new build.

Although all KFD-professionals are also inspectors supporting the field inspector, an important part of their job is assessing documents submitted by LHs in accordance with licence requirements. Assessments are performed e.g. in the framework of plant or organisational modifications and periodic safety reviews. Six professionals are available full-time to conduct routine installation inspections and audits (field inspectors). One of these field inspectors is dedicated full time to the inspection of Borssele NPP. However, during refuelling, all field inspectors and a number of experts are involved in the inspections.

The basic key to deploying staff to the different types of nuclear installations is the potential safety risk. But other factors also have their influence, like operational occurrences and incidents, inspection findings or public attention.

It should be noted that in addition to the KFD, there are other inspectorates contributing to the supervision of the activities of LHs. Some of these are mentioned in section 8.1.c.

8.1.c Coordination of activities between the several entities of the RB

In addition to day-to-day contacts between the entities of the RB, there are periodic meetings at managers and directors levels. There is also communication with institutes that provide the RB with expert information. Examples of regular meetings are:

[37] Dutch: 'Team stralingsbescherming en samenleving'

[38] Any citizen, governmental body or private company wanting to apply ionising radiation for whatever purpose has to (1) apply for a licence to do so, or (2) if according to applicable law a licence is not needed, has to notify Agentschap NL of it's intended application of ionising radiation.

- Between pdNIV and KFD;
- Between pdNIV and ILT/crisis management;
- Between KFD and ILT/crisis management;
- Between pdNIV and Agentschap NL;
- Between Agentschap NL, pdNIV, State Supervision of Mines (SdoM), and inspectorates of the ministries of Social Affairs & Employment (SZW) and Health, Welfare and Sports (VWS);
- Between KFD, State Supervision of Mines (SdoM), and inspectorates of the ministries of Social Affairs & Employment (SZW) and Health, Welfare and Sports (VWS);
- Between KFD and the National Institute for Public Health and the Environment (RIVM);
- Between pdNIV and the National Institute for Public Health and the Environment (RIVM).

8.1.d Coordination of activities for managing nuclear accidents and incidents

Refer to the text on Article 16 on Emergency Preparedness for the relevant details.

8.1.e Development and maintenance of Human Resources at the RB

Disciplines and training

The expertise of the RB spans disciplines like radiation protection, nuclear safety, risk assessment, security and safeguards, emergency preparedness, legal and licensing aspects. Via the RB an annual contribution is provided to support the work of the National Institute for Public Health and the Environment (RIVM). RIVM provides scientific support to several ministries, including the ministry of Economic Affairs.

For areas in which its competence is not sufficient or where a specific in-depth analysis is needed, the RB has a budget at its disposal for contracting external specialists. This is considered one of the basic policies of the RB: the core disciplines should be available in-house, while the remaining work is subcontracted to third parties or Technical Service Organisations (TSOs).

The inspectorate of the RB (the KFD) cooperates for its inspection programme with other national and regional regulators, like the industrial safety inspectorate, the regional fire brigade, provincial and community supervisors. Also within the ILT cooperation takes place with several domains like the domain of road transport (dangerous good transport supervision) and the domain of air transport (safety culture/safety management).

The Regulatory Body (RB) provides tailor-made training for its staff.

Apart from the general courses, training dedicated to the technical discipline is provided. This includes international workshops, but also conferences and visits to other regulatory bodies. In addition there is information exchange through the international networks of OECD/NEA, IAEA, EU etc. To be mentioned are the contributions to WENRA, ENSREG, TRANSSC, RASSC, NERS, NEA/CNRA and several of its Working Groups. Experts have to keep up to date with developments in their discipline and are also responsible for maintaining a network for a number of other disciplines that are not permanently available. It is the policy of the RB that the core experts have sufficient knowledge to specify and assess work done by external experts.

Manpower situation

The pdNIV has about 36 fte, Some are dedicated to general radiation protection issues, and others to nuclear licensing and safety, security and safeguards issues related to all nuclear facilities and nuclear transports.

Most other applications and licensing activities like general radiation protection, are outsourced to the ‘Agentschap NL’, which is a service organisation, that executes programmes and regulations for many ministries and other governmental organisations. About 14 fte are dedicated to this type of work.

KFD has a staff of about 37 fte. Its expertise spans the major disciplines relevant for reactor safety, radiation protection, security and safeguards and emergency preparedness.

The RB has contracted severel projects to German TSO GRS. In 2013, the inspectorate of the RB (the KFD) concluded a 4-year framework contract with GRS, for support in the assessment of nuclear installations. Furthermore the RB concluded a 4-year framework with the Dutch consultancy firm NRG.

8.1.f Openess and transparency of regulatory activities

Parliament is actively informed by the RB via the minister of Economic Affairs.

Stakeholder involvement is embedded by public consultation during the licencing process and in the process of the Environmental Impact Assessment (EIA) under the Environmental Protection Act. This process also involves meetings of RB, LH (LH) and the public. The RB is transparent in its communication of regulatory decisions to the public; these are published with supporting documentation on the governmental websites.

The RB is aware of the different backgrounds of informed groups and the general public. The ministries, of which the RB is part of, often produce easy to understand press releases, as well as detailed reports. Of some reports, there are detailed as well as summary versions (in the Dutch language). The RB publishes its findings related to the performances of the LHs on governmental websites.

8.1.g Future and current challenges for the Regulatory Body

Long Term Operation (LTO) of the Borssele NPP, post Fukushima Daiichi safety re-assessments, and initiatives in the Netherlands for nuclear new build (PALLAS research reactor) and upgrade projects, face the RB with major challenges. One is providing adequate number of governmental staff with sufficient expertise to oversee the licensing procedures.

The following measures have been taken to meet these challenges:

- Anticipating increasing workload, a formal request for expansion of the personnel and financial budget was sent to the cabinet in March 2010. Since then, the RB has seen a steady increase in staff. Also relative young staff could be attracted with expertise on reactor engineering and other relevant disciplines.
- The RB currently has adequate resources to perform its tasks. In the future the RB may be faced with challenges in terms of assuring sufficient resources.
- As far as the financing is concerned, currently adequate financing is available. There is regulation managing the contributions of LHs to the costs of regulatory activities. This regulation is being changed to better cover the costs of these activities. Refer to the text on Article 7 for more information.
- The 4-year framework contract with German TSO GRS. will provide support in the assessment of existing installations and the preparations for the PALLAS reactor.

In 2011 the events in Fukushima Daiichi sparked many international activities (led by IAEA/CNS, EC/ENSREG and OECD/NEA) in the field of safety reevaluations and margin assessments, all subject to international peer review. The Netherlands, via its RB contributed to all of these initiatives. Also the follow-up of these initiatives increased (and still increases) the workload at the RB.

In addition various issues at nuclear facilities (not being NPPs) deserved extra attention.

The RB regularly contracts the German TSO for multiple tasks. The RB is considering the effects of the German phase out on the future expertise of this TSO. It also considers the loss of operating experience in Germany for the LH in the Netherlands, that operates a German-type NPP. Therefore an

action has been defined in the National Action Plan (post Fukushima) to evaluate the consequences of this. One idea is that together with regulators in other countries with Siemens-KWU design a platform could be established to exchange ideas and share experiences.

In 2014 there will be a IRRS mission visiting the RB. In preparation of the IRRS mission, the RB is in the process of an extensive self assessment.

8.1.h Statement on adequacy of resources at the Regulatory Body

The Netherlands states that the resources at the RB currently are adequate, in terms of Human Resources (number of staff and expertise) and financing. Nevertheless the current workload is recognized and options to more efficiently and effectively coping with the workload are studied.

8.1.i External Technical Support

The RB can rely on various national and foreign organisations that regularly provide technical support. In this section the most important of these are introduced. The RB will continue to cooperate with foreign Technical Support Organisations (TSOs) for evaluating safety cases of Dutch LHs.

Governmental supporting organisation RIVM

The National Institute for Public Health and the Environment (RIVM) is a specialised Dutch government agency. Its remit is to modernise, gather, generate and integrate knowledge and make it usable in the public domain. By performing these tasks RIVM contributes to promoting the health of the population and the environment by providing protection against health risksand environmental damage.

The RIVM among others coordinates the back-office of the National Nuclear Assessment Team for radiological analyses and information (BORI). The RIVM supports the Ministries with scientific studies. RIVM works together with other (governmental) expert organisations as the Royal National Meteorological Institute (KNMI) with models for the prediction of the effects of discharges of radioactive material in the air. RIVM also operates the national radiological monitoring network.

Education and training organisations

The RID/R3 organisation at the Technical University in Delft and the Nuclear Research & consultancy Group (NRG) in Petten and Arnhem provide education and training in nuclear technology and radiation protection to clients from nuclear and non-nuclear businesses and various governmental organisations.The RB for the education on Radiological Protection, also contracts various other universities.

Dedicated trainings on various topics are also contracted by the RB with other national and foreign supporting organisations.

For the education and training in radiation protection a national system exists with four levels of education. The government recognizes training institutes for a specific training of radiation protection. For getting a degree in radiation protection, an exam has to be passed.

A change in the system of education for radiation protection is under construction. Registration of radiation protection experts of the levels 2 and 3 is being implemented. There are formal requirements to obtain registration certificates for the initial education, for continuing education and for work experience.

Technical Support Organisations (TSO)

To date there is no national dedicated TSO. Organisations are contracted on Ad Hoc basis to support the RB with various tasks. Support is provided by foreign TSOs and national and international consultancy organisations. Some major supporting organisations are listed below.

GRS, Germany

The Dutch Regulatory Body (RB) cooperates with a Technical Support Organization (TSO) from Germany, GRS. This is a TSO for the German national regulator and one of the large German TSOs. In the Netherlands it evaluates safety cases and provides other types of consultancy to the RB. In addition GRS provides associated education and training for governmental and commercial organisations.

GRS currently has a major framework contract with the RB.

NRG, Netherlands

The Nuclear Research & consultancy Group (NRG) in Petten and Arnhem provides consultancy & educational services to government and industry. The company has implemented 'Chinese Wall' procedures to protect the interests of its various clients and avoid conflicts of interest. NRG currently has a framework contract with the RB.

8.1.j Advisory Committees

To date there is no standing advisory committee on nuclear safety; an advisory committee (the Reactor Safety Commission) is formed on an ad hoc basis as required. The RB at any time can install a Commission dedicated to any required issue.

With a licence application, under certain conditions it is compulsory to conduct an Environmental Impact Assessment or EIA (Dutch: milieu-effectrapportage, m.e.r.). The Netherlands has a permanent institute, the Commission for the Environmental Assessment ('Commissie voor de m.e.r.', Cmer) that can be asked to advise on the requirements of all EIAs conducted in the Netherlands, including those related to nuclear facilities.

8.2 Status of the Regulatory Body

8.2.a Governmental structure

As described in section 8.1.a, the RB for Nuclear Energy Act issues has three main components: the pdNIV (developing policies and issuing licences), Agentschap NL (supporting licencing activities) and the inspectorate of the RB (KFD) performing review, inspection and enforcement. It should be noted that in addition to the KFD, there are other inspectorates contributing to the supervision of the activities of LHs. Some of these are mentioned in section 8.1.c.

8.2.b Future development of the Regulatory Body

The minister of Economic Affairs (EZ) has requested the IAEA to perform an Integrated Regulatory Review Service (IRRS) 'full scope' mission in the Netherlands. The IAEA has agreed to have an IRRS mission visit the Netherlands in 2014. In preparation the ministry of EZ has conducted a first tentative analysis of the compliance of the Netherlands with the requirements defined by the IAEA. This analysis has considered the way the 'Competent Authority' has been defined and the functioning of the several entities of the Regulatory Body (RB). Proposals are being developed to further improve the application of international rules. A number of these can be implemented before the start of the IRRS mission. Some proposals may also have an impact on the development of the regulatory framework in the Netherlands.

Various organisational options that may strengthen the RB are being studied. One of the options is to bring together in one entity various organisations that currently constitute the RB. Such an entity may provide major advantages in terms of efficiency, HR management and maintaining the required expertises. A resolution requesting such a development of the RB into one entity was accepted almost unanimously in Parliament on March 12, 2013. The minister of Economic Affairs has ordered a legal

analysis that will support a proposal to establish one single national Authority for Nuclear Safety and Radiation Protection (ANVS[39]). The proposal will satisfy international requirements. Various ministries are involved in the preparations that will establish ANVS as a competent and independent body for the regulation of nuclear safety, security, radiation protection, transport safety and waste management.

8.2.c Reporting obligations

The RB reports to the minister of Economic Affairs (EZ). The minister of EZ reports to Parliament on nuclear safety, radiation protection, and other Nuclear Energy Act issues.

Results of major studies, conducted under the authority of the RB are presented by the minister of EZ to Parliament. In addition, Parliament can and will now and then require the minister to report to Parliament on specific issues in which MPs may have expressed an interest.

Every year the ILT prepares a report of its inspection activities and its findings, including those of the KFD. This publication is made available to the public on the ministry's website. In addition KFD prepares an annual report on nuclear incidents to the Dutch Parliament. KFD is also developing its own part of the ILT-website.

The ministry of EZ has extensive dossiers on many issues published on its website, featuring many in-depth studies on issues related to nuclear-related activities. Information on all major LHs can be found online too. This is part of the ministry's policy on transparent governance.

8.2.d Separation of protection and promotion

The RB is not in any way involved in energy policies. Its involvement with nuclear power is restricted to nuclear safety and radiation protection and associate issues.

[39] Dutch: 'Autoriteit Nucleaire Veiligheid en Stralingsbescherming' (ANVS).

ARTICLE 9. RESPONSIBILITY OF THE LICENCE HOLDER

9. Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such Licence Holder meets its responsibility.

Regulatory basis
The principle that the ultimate responsibility for safety lies with the Licence Holder (LH) is established in the legislation at several levels.

First of all the Nuclear Energy Act prescribes that the LH must produce a safety case for a new NPP or a substantial modification of an existing NPP to support its application for a licence. The Regulatory Body (RB) shall assess this safety case and can only refuse to grant the licence in case this safety case does not satisfy the requirements.

Secondly the Nuclear Energy Act, in the explanatory memorandum on Article 37b, states that the LH must operate the installation in such a way as to reflect the most recent safety insights.

Since 2011, as mentioned already in the text on Article 7, the EU-Nuclear Safety Directive, as adopted in 2009, was put into force in the Netherlands. One of the articles states that the prime responsibility lies with the LH. This includes the requirement to develop a institutional safety policy at the corporate level and pursue continuous improvement.

In the licence of Borssele NPP, as a licence condition the NVR NS-R-2 , a Dutch application of the IAEA document is applicable. Several articles deal with the responsibilities of the operating organisation with respect to safety..

The licence also states that the LH must review the safety of the plant at both two-yearly and 10-yearly intervals (Periodic Safety Reviews, PSRs). Safety evaluations are described in more detail in sections on other articles of the Convention.

Refer to the section on Article 10 of the Convention for further details.

The LH’s own Management System and internal verification organisation are important mechanisms enabling the LH to adhere to the licence and achieve its corporate safety objectives.

NVR-GS-R3 (Management Systems) stipulates that the responsible organisation (i.e. the LH in most cases) shall retain the overall responsibility if work is delegated to other organisations.

Other obligations
With the Covenant of 2006, the LH of the NPP Borssele has agreed to comply with the obligation to remain within the class of 25% of safest reactors in the Western world for its lifetime until 2034.

The EU-directive on nuclear safety adopted in 2009 and to be implemented in 2011 further dictates the LH’s responsibility for nuclear safety and the obligation for continuous improvement of safety.

Monitoring and enforcement of compliance
Compliance with the licence and its terms is monitored by by the inspectorate brance of the RB (the KFD) by means of an appropriate supervision programme, including international safety missions, as already discussed in the section on Article 7. Periodic safety missions are carried out at the Licence Holder (WANO Peer reviews). In preparation of the mission, often the LH conducts a self assessment. KFD has always access to the results. Every ten years an OSART mission will be invited. In response to the IAEA actionplan post-Fukushima, it has been decided to invite an OSART mission within three years. The mission will visit the NPP in September 2014, one year before the originally planned date.

Two modules will be added on top of the standard mission: Corporate OSART and Independent Safety Culture Assessment. An international mission schedule for the next 20 year period will be drawn up.

An example of the KFD enforcement of compliance is the HFR-case, where a leakage of the primary circuit to the pool made clear that there is room for improvement of the present ageing inspection programme. The LHwas requested to restore the safety boundary in a proper way before it would be allowed to restart the reactor and investigate if there are other places where the inspection effort might need to be enhanced.

EPZ activities and developments in communication and transparency to the public

EPZ has adapted its communication policy towards public communication developed specifically for the general public. EPZ fully recognises its obligation to communicate openly about the company and its plants to the general public with factual, reliable and understandable information. Its communication has been being changed from 'sender oriented' to 'receiver oriented'.

Examples include all (post-)Fukushima communication, such as the EU-'stress test', and the publication of all formal event notifications to the regulator.

Its prime means of communication is its web site, but press conferences and interviews are used as well.

CHAPTER 2(C) GENERAL SAFETY CONSIDERATIONS

ARTICLE 10. PRIORITY TO SAFETY

10. Each Contracting Party shall take the appropriate steps to ensure that all organisations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety.

10.1 Policy on nuclear safety

10.1.a Regulatory requirements and implementation

The whole process of the design, construction, operation and decommissioning of a nuclear power plant in the Netherlands (as well as the licensing of all these stages) is characterised by a high priority given to safety at all stages. This is laid down in the Nuclear Energy Act, which requires (Art. 15c) that licence conditions shall be put in place in order to provide for the best possible protection against any remaining adverse consequences of operating a nuclear facility, unless this cannot be reasonably required. In the licence, a requirement is to comply with the Safety Requirements for nuclear power plant operation, NVR NS-R-2 (Safety of NPPs: Operation). This document requires that the operating organisation must be aware of the special emphasis that needs to be placed on safety when operating nuclear power plants. This special emphasis and commitment to safety must be reflected in the organisational structure.

NVR-NS-R-2 also states that plant management has a direct responsibility for the safe operation of the plant. All safety-relevant management functions, such as decisions on financial, material and manpower resources and operating functions, must be performed and supported at the most senior level of management.

NVR GS-R-3 requires the Licence Holder (LH) to establish a management system where priority to safety is paramount.

10.1.b Licence Holder's (EPZ's) policy and organisation

The policy plan of the Borssele utility is worth quoting in this context. It describes the priority attached to safety in relation to that given to financial considerations as follows:

The prime objective of EPZ is the production of electricity in a cost effective way, but the environmental risk involved in nuclear generation demands that the highest priority be given to nuclear safety (overriding priority).

In addition, the following policy statement can be found in the objectives of the Management System of the Borssele NPP:

Operation consists of a safety function, i.e. maintaining and improving operational and nuclear safety, and an economic function, i.e. producing electricity. The economic function will only be fulfilled if the nuclear power plant is safe, from a process and technical viewpoint, and if the safety function is being fulfilled in an adequate manner. The 'conditions for operation' and the 'limits' as laid down in the Technical Specifications must be observed at all times.

This is reflected in the plant's top management: the Plant Manager (PM) is responsible for the economic function: economic production in accordance with licence and with nuclear safety as overriding priority). The PM reports to the director of operations (COO). The head of the power plant (CNO) bears full responsibility for nuclear safety and radiation protection. The CNO has power of enforcement when nuclear safety or radiation protection is being challenged. The internal nuclear safety advisory board (RBVC) advises the CNO on nuclear safety and radiation protection issues. The CNO reports directly to the CEO. This ensures that safety is given a proper role in this economically oriented environment.

EPZ has several independent bodies to support top management with respect to (nuclear) safety, radiation protecten and (radiological) environmental issues. The most important are:

ALARA Committee	Its function is to advice the CNO (and RP manager) on Radiation Protection issues.
RBVC	(Internal Nuclear Safety Committee). Its function is to advice the CNO on nuclear safety and RP-issues.
ERBVC	Its function is to advice the CEO on organisational issues, in particular by evaluation of the nuclear safety performance of the plant and the performance of the RBVC.
NV&KZ[40]	Nuclear Safety & Quality Assurence department.This is a dedicated department for independent supervision on nuclear safety, radiation protection and quality assurance. Its manager reports directly to the CEO of the company.

Where new safety insights emerge, their relevance to the NPP is scrutinised and modifications are initiated if they are found to offer sufficient safety benefits to justify their cost. Although there is no formal requirement in the Netherlands to carry out a cost-benefit analysis, practical experience (such as the major back-fitting programme at Borssele) has shown that the modifications have comfortably met the criteria applied in other countries. EPZ has documented itself a cost-benefit procedure, where amongst other things a certain money value is related with the improvement of the core damage frequency. As already mentioned, regular safety improvements have to be performed. At two-yearly intervals the operation of the plant must be evaluated against the existing licence requirements and at 10-yearly intervals a thorough safety evaluation against modern safety requirements and current safety insights for design, operation, personnel and administration aspects. These Periodic Safety Reviews (PSRs) and the resulting improvement or modification projects are aimed solely at further improvement of plant safety.

The LH (EPZ) of the Borssele plant is a member of WANO. The director of EPZ is member of the board of WANO Paris centre. Further EPZ is member of the Framatome-ANP Reactors Owners Group and the German VGB, which provide a valuable source of information. Personnel take an active part in international WANO and OSART missions.

10.1.c Supervision of priority to safety

Supervision is one of the tasks of the Regulatory Body (RB). The inspectorate of the RB (the KFD) uses the following general approaches.

First KFD pays attention to developments regarding the NPP with respect to annual budget, management, nuclear leadership and position of shareholders to make sure that safety is properly

[40] NV&KZ, Dutch: 'Nucleaire Veiligheid & Kwaliteits Zorg'.

prioritized.

Secondly KFD pays attention to subjects and events the NPP organisation declares as purely economical. KFD assesses the assumption of the NPP that safety aspects play no role in the subject or events concerned.

Finally KFD continues to emphase the importance of periodic safety reviews and continuous improvement.

Further some more detailed examples of the practice of supervision are:

- Justifications of continued operation and their evaluation by the RB.
- Temporary modifications and their evaluation by the RB.
- Issues of gradual degradation, although the safety requirements keep being met. In these cases the KFD will urge the LH to act and restore the original situation. This has been the case with the concrete condenser cooling and component cooling lines. The latter have been replaced in 2012. At the same time, KFD requested the improvement of the physical separation of these lines.

The global description of the NPP organisation, including specifications of competences and authorities for key staff, is part of the Technical Specifications. On top of that there has been introduced a new licence condition to submit a safety case for organisational changes with safety relevance and it is therefore subject to regulatory review and inspection. In the years 2004-2006 there was a major cost savings operation (-15%) due to market conditions. This meant a personnel reduction of about 10%. At the same time the number of reported incidents had gradually increased. This attracted the attention of the KFD. The 2006 Covenant allows operating the NPP till 2034. This faces the LH with the challenge to carry out a number of important tasks at the same time: (1) project Long Term Operation, (2) 3rd Periodic Safety Review, (3) replacement of analog electronics and (4) staying within the class of 25% safest plants in the western world. According to KFD, this requires a major increase of the number of staff and financial means. Therefore KFD has been supervising these developments very closely. Mainly focussing on the pro-active long term management, the size of the NPP organisation has increased. Additional information is presented in the sections on Articles 11 and 14 of this national report to the Convention.

The inspectorate’s policy and ambition is to closely follow international safety developments by participating in several international committees. The information is amongst others used to evaluate the safety insights and improvements that the NPP organisation is proposing.

As an illustration of the high priority given to safety, it is worth mentioning that the Netherlands participates actively in the Incident Reporting System and has bilateral contracts with Belgium and Germany with regard to the evaluation of incidents. At the moment the activities related to foreign incidents are focussed on post-Fukushima activities.

10.2 Safety culture

10.2.a Requirements

Basic requirements are adopted from NVR-GS-R-3, referenced in the licence of Borssele NPP.

10.2.b Safety culture at NPP Borssele

The staff of the Borssele NPP is fully aware of the necessity of having safe working conditions and practices to avoid any harm to humans, installation or environment. The policy is to execute no activity until it is ensured that it can be done safely. Integrated risk analysis, procedures, instructions, checklists, training programs, etc. have been developed to ensure that import safety considerations are not forgotten or overlooked when planning and carrying out the work. Pre-job briefings and last

minute risk assessments are used as last safety barriers and independent safety inspectors are employed for monitoring and oversight.

Although all these elements are in place, continuous improvement and alertness are necessary. The increasing number of reported incidents in 2006 and evaluation of international practice has led to an increased and strong effort by LH to improve the safety culture. Most important ‘instrument’ to achieve this, is a human performance and safety culture programme which has been introduced in 2007.

Safety performance is monitored and evaluated by LH to discover underlying causes and trends. In addition independent safety assessments, like reviews by safety specialist from peer companies, are used to identify areas for improvement. Also WANO peer reviews contribute to further improvement as WANO measures performance against best practices in industry. Most important area’s for improvement which were identified during last (peer) reviews and which will help LH to close the gap to excellence are: leadership, performance measurement and operating experience. Action plans are being developed and implemented by LH. Focus will be on the reinforcement of management expectations, strengthening ownership and a restructure of the management system to improve the continuous improvement cycle.

Next independent ‘progress measurements’ will be the WANO follow-up review in 2014 and the Independent Safety Culture Assessment by an OSART mission in September 2014. The OSART mission will be carried out with as an additional module the Independent Safety Culture Assessment. Also KFD is monitoring safety performance and trends as the subject is addressed in meetings between LH and KFD.

10.2.c Supervision of safety culture

Although no formal criteria have been developed to measure ‘safety culture’, the inspections performed by the RB include monitoring the LH’s attitude to safety. For several years KFD used the socalled KOMFORT method to monitor safety culture, a method developed in Germany. KFD is planning to integrate safety culture in the supervision program using IAEA guidance.

A yearly meeting with the LH about achievements and development of safety culture and human performance has been organised on the initiative from KFD since five years. From 2014 the meeting scope will be enlarged to cover all organisational issues.

Safety culture is also a subject in the OSART missions initiated by the KFD. The next OSART mission will take place in September 2014. At the request of the NPP this time a special module “Independent Safety Culture Assessment” will be added.

More details on the safety culture at the Borssele NPP are given in Appendix 3.

In the past there have been safety culture problems at the HFR in Petten. In order to verify the situation, in the second half of 2008, KFD conducted a safety culture audit, using the IAEA-SCART guideline. The main conclusion was that still improvements were possible. The LH was advised not to reduce efforts in this area, to prevent jeopardizing the achievements. In 2012 KFD carried out a followup audit with the following conclusions:

Improvements have been made since 2008 however more attention has to be given to a more systematic approach of safety culture, external assessment of safety culture and a more consistent approach of safety culture on corporate level.

Appendix 7 contains detailed information about the HFR and – among others – the safety culture improvements.

10.3 Management of safety (including monitoring and self-assessment)

10.3.a Requirements

Main requirements are recorded in NVR-GS-R3; this NVR is referenced in the licence.

10.3.b Self-assessment by LH (EPZ of NPP Borssele)

Organisational aspects have been described in para 10.1.b.

Self-monitoring is mostly based on performance indicators. The feels that the use of performance indicators should be enhanded and expended. This need is supported by the self-assessments and the WANO Peer Review.

Relevant self-assessments include:

- Yearly evaluations and reporting on plant functions, such as operational experience feedback, surveillance and in-service-inspections, ageing management, RP, radiological releases, and radwaste. (some of them are a licence condition)
- Two-yearly evaluation of the current licensing basis.
- Ten-yearly periodic safety reviews.
- NV&KZ (department for independent supervision) inspection and audit programme.

Independent safety assessments invited by the plant include WANO Peer Reviews and WANO Technical Support Missions. The regulator invites the IAEA, for OSART, SALTO, IPPAS, and IPSART missions.

Currently EPZ is in the process of implementing an integral management system based on the GS-R-3 requirements.

10.3.c Supervision of safety management (including monitoring and self-assessment)

The assessment of the safety management system of the License Holder is part of the KFD surveillance program. KFD pays attention to effectiveness of the safety management system during the assessment of changes of the organisation and/or procedures and during incident analyses. Further reference is made to article 13.

10.4 Safety culture at the Regulatory Body

A strong safety culture at the License Holder is an important topic in the oversight exercised by the Regulatory Body (RB). Within the RB safety culture is build up by several parts implicitly, e.g. the application of the four eyes principle. In the framework of the preparation for the upcoming IRRS-mission the explicit procedures and approaches to take care about safety culture for the regulator will be developed. Information from other regulatory bodies will be taken into account. First contacts have been made.

ARTICLE 11. FINANCIAL AND HUMAN RESOURCES

11.1 Each Contracting Party shall take the appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its life.
11.2 Each Contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety related activities in or for each nuclear installation, throughout its life.

11.1 Adequate financial resources

11.1.a Social and economic background

In the last 15 years operators of electric power generating systems have had to cope with political and social changes as well as new economical and technological factors. Examples of these changes and factors are electricity market liberalisation, increasing oil and gas prices and constraints in their availability, growing environmental constraints and extraordinary ICT development.

Liberalisation
The European electricity market is undergoing major changes. Prompted by EU legislation, the EU member states are restructuring their electricity sector to allow for more competition. A well-functioning competitive European electricity market should deliver on access to competitive electricity prices, on security of supply and ensuring investments. Due to liberalization of the electricity market, several competing operators are created and the market is still changing. As a result of these developments electricity companies consider different alliances and merging options.

In all EU countries, the European electricity market introduces new dynamics. The interest in commercial and economical aspects has increased. Therefore regulatory attention on the relationship between production and safety is continuously required.

Unbundling
In the past, the electricity markets were almost completely controlled by the electricity companies with large, vertically integrated utilities that used to be regulated by state monopolies. These companies typically owned almost all generators, as well as transmission and/or the distribution network. Such ownership pattern is believed to be an obstacle for free competition. The EU's executive body has been a strong advocate of unbundling generation and network activities to prevent these companies from using their influence to reduce competition. Several EU countries are opposed to full unbundling. As a compromise, European states are free to choose from several options to promote competition.

11.1.b Legislative aspects of responsibility and ownership

The principle that the ultimate responsibility for safety lies with the Licence Holder (LH) is laid down in several layers of regulation. The highest level is the Nuclear Energy Act where in the explanatory memorandum of Article 37b it is stated that the LH must operate a nuclear facility in a manner that reflects the most recent safety insights. More about this can be found in the text on Article 9.

The Nuclear Energy Act contains a number of articles, which deal with criteria, interests and conditions under which a licence can be awarded. The explanatory memorandum on Article 70, which states that a licence is to be awarded to a corporate body, refers to guarantees of necessary expertise and trustworthiness in relation to safety. Trustworthiness in relation to safety can amongst other things also be associated with financial solvability.

The licence does not automatically pass to the LH's successor in title. In the case where major changes in ownership of EPZ (LH of the Borssele NPP) are planned, the LH is obligated to inform the regulator three months in advance. Article 70 of the Nuclear Energy Act stipulates that any transfer of ownership must take place with the consent of the ministers who issued the licence. This allows the authorities to assess whether a potential LH can offer the same standard of expertise, safety, security etc. as the previous one. The authorities will refuse to issue a licence to a potential LH where a change in ownership alters certain circumstances that are of vital importance from a licensing point of view, including adequacy of financial provisions.

LH EPZ (owner of Borssele NPP) is a private company with two shareholders. Changes in shareholders and a transfer of shares between them have resulted in a majority shareholder (public company, with 70 %) and a minority shareholder (private company, with 30%). The changes in shareholders have led to the conclusion of an agreement between the shareholders and the Dutch government on public interests concerning the (shares in) the nuclear power plant ("convenant publieke belangen kerncentrale Borssele"). The agreement, among others, concerns safeguards on public interests when operating the power plant and sets criteria and procedures to follow should a shareholder wish to transfer (part of) its shares.

11.1.c Rules and regulations on adequate financial resources for safe operation

NVR NS-R-3, NVR NS-G-3.1 and NVR NS-G-3.2 are referenced in the licence of Borssele NPP. It contains no direct requirement to have adequate financial resources. To ensure the safe operation of an NPP, it does require the LH to cope with the costs for safe operation. For instance, it stipulates that the management of an NPP must act promptly to provide adequate facilities and services during operation and in response to emergencies. The personnel involved in reviewing activities have to have sufficient independence from cost and scheduling considerations. This applies to reviews of all safety-related activities.

The requirement to provide these services and facilities implies the requirement to provide the necessary financial resources for them. In the near future an actualisation of the regulation on this topic will be proposed, based on the guide NS-G-2.4 (The Operating Organization) and guide NS-G-2.8 (Recruitment, Qualification and Training of Personnel).

11.1.d Financing of safety improvements at Borssele NPP

A major policy principle of the LH is the overriding priority of nuclear safety. This includes that LH's management will act promptly to provide adequate facilities and services during normal operation and in response to emergencies.

The LH's policy is part of the EPZ corporate plan. The corporate plan comprises a period of three years and is drawn up every year. They are presented to the corporate shareholders for approval. One of the main programmes in the corporate plans is the continuous enhancement of the nuclear safety on the power plant. From the corporate plan every year there will be written an annual plan for implementing the programmes.

Before those annual plans will go to the shareholders, they have undergone an internal budgeting process to finance the programmes for that year. During that budgeting process the Quality Assurance Department will see to it that the budgeting process does not have negative consequences for nuclear safety.

According to the licence the LH has to do a periodic safety review every two years (against the current licence conditions) and a more thorough safety evaluation (against the state of the art) every ten years. In the 10 yearly evaluations, the evaluation points will be assigned with safety significance on basis of:

- A deterministic approach described in the NVRs and IAEA Safety Standards;

- A probabilistic approach (PSA) with emphasis on the significance for the core damage frequency and individual risks;
- Considerations from the perspective of radiation protection for workers, the public and the environment;
- The defence-in-depth approach according to INSAG 10.

This evaluation will result in a list of possible actions to improve the safety. On a basis of cost-benefit considerations, it is decided which measures from that list will be implemented within a certain timeframe.

Because the operating life of the Borssele NPP is anticipated to be 60 years, a number of investments has to be made in the near future:

- Long Term Operation project, giving attention to among others ageing issues;
- Replacement of analog electronics by digital I&C;
- Proactive replacement of a large number of components, the reliability of which may not be guaranteed until the new end date of operation;
- Complete overhaul of the Final Safety Analysis Report (FSAR) based on the next Periodic Safety Review;
- Redesign of the organisation;
- Continuous striving for excellence;
- Fukushima lessons learnt.

11.1.e Rules and regulations on financial resources for waste management activities

The Netherlands' policy on the management of radioactive waste and spent fuel is to isolate, control, and monitor radioactive waste in above ground structures for an interim period of at least a hundred years, after which geological disposal is foreseen. During the period of interim storage all necessary technical, economical, and social arrangements are to be made in such a way that geological disposal can really be implemented afterwards.

Implementation of this policy lead to the establishment of COVRA, the Central Organisation for Radioactive Waste, located in Borsele. COVRA is a 100% state owned organisation, and is the only organisation allowed to manage and store the radioactive waste and spent fuel. Upon transfer to COVRA, COVRA takes over all liabilities, including the responsibility for final disposal.

According to the generally applied 'polluter pays' principle, the generator of the waste is charged for all costs related to the management of radioactive waste and spent fuel, including the envisaged costs for final disposal. Once the transfer of the waste has been accomplished, the customer is exempted from further responsibility for the waste. No surcharges can be made to make up for exploitation losses by COVRA and no waste can be returned to the customers.

With regard to the management of Spent Fuel (SF) and High Level Waste (HLW), the utilities and the operators of research reactors agreed to jointly build a facility for treatment and long-term storage of Spent Fuel (SF) and High Level Waste (HLW) at the COVRA site. This building (HABOG) was commissioned in 2003 and is now receiving vitrified and other HLW from reprocessing plants as well as SF from the research reactors. Both the construction costs and the operating costs are borne by the generators of the SF and the waste.

For Low and Intermediate Level Waste (LILW) there are fixed tariffs for specified categories of radioactive waste, which take into account all management costs. While the tariffs are annually adjusted with the price index, every five years the tariff structure is evaluated with the aim to reconsider the need for any structural adjustment. However, the utmost restraint is exercised to any proposal for an increase of the tariffs, in order to prevent the temptation of environmentally irresponsible behaviour with the waste by the customer.

While it is recognised that COVRA as a waste management agency has a public utility function, negotiations with the utilities on the transferral of shares to the State have resulted in an agreement in which they take a fair share in the future management costs of COVRA for this category of radioactive waste. This sum was disbursed to COVRA in the framework of the transfer of ownership of COVRA to the State and put in a separate fund which is managed by COVRA. Every 5 years since the basis for the cost estimate has been re-assessed.

For LILW a separate procedure is followed: COVRA raises a surcharge for waste disposal on the fees of generators of radioactive waste. This sum is added to the fund.

For more information waste management issues, refer to our national report for the ‘Joint Convention on the Safety of Management of Spent Fuel Management and on the Safe Management of Radioactive Waste Management’.

11.1.f Rules and regulations on financing decommissioning

According to new legislation in force since April 2011, a nuclear facility shall be decommissioned directly after final shut down[41]. Decommissioning implies the implementation of all administrative and technical measures that are necessary to remove the facility in a safe manner, and to create an end state of ‘green field’. Therefore, the LH is required to develop a decommissioning plan, describing all the necessary measures to safely reach the end state of decommissioning, including the management of radioactive waste. This decommissioning plan shall be periodically updated, and shall be approved by the Regulatory Body (RB).

The new legislation also requires the LH to make available adequate financial resources for decommissioning at the moment that these are required. Therefore, the LH will have to calculate the costs of all the activities described in the decommissioning plan, and provide for a financial provision offering sufficient security that all costs are covered at the envisaged start of decommissioning. The LH is free to choose the form of the financial provision; however, it shall be approved by the authorities.

Also refer to the text on Article 7 of the Convention for the recent updates of the legislation.

11.1.g Statement regarding the adequacy of financial provision

Currently, the financial provisions of the LH seem adequate.

The 70% majority owner of EPZ is DELTA a company for 100% owned by the municipalities and the province. The other 30% is owned by RWE. Both companies have a stable performance and adequate financial ratings (Standard and Poors).

Nuclear safety has overriding priority within the company. Shareholders are aware of the importance of high performing on nuclear safety. Costs for safety improvements are considered as an integrated part of the operation costs. A high safety level, demonstrated by a good safety record is considered as an essential component of the business concept.

EPZ annually invests 5-20 M€ of which 30%-60% safety related. Investments necessary for (improving) safe operation are not evaluated on a commercial or economical basis. From EPZ and its shareholders perspective safety related investments are a duty of a nuclear operator and a licence to operate instead of a possibility to decide on.

Up to now EPZ has been allotted enough financial resources for maintaining the appropriate level of nuclear safety by its shareholders. The price of a kWh of electricity produced in the EPZ NPP is set out by the management and approved by the shareholders (who are also the only customers), based on

[41] The NPP Dodewaard, brought into a state of Safe Enclosure in 2005, is excluded from this requirement.

the yearly business plan. Such a price covers all gross operating expenses, i.e. electricity generation costs as well as necessary investments. Besides this, the shareholders annually approve the Long-term Investment Plan.

The adequacy of EPZ's financial system and internal controls is assessed by an external auditor. According to the safety and security charter, the management hereby is committed to provide all necessary financial means to enhance safety and to ensure all required security measures.

11.1.h Supervision of financial arrangements and provisions

The sufficiency and adequacy of the budget of the LH for safety is not checked by inspection by the RB. The subject is discussed however during periodic management meetings and also in the case of larger investments (e.g. improvements from the periodic safety review).

In the case of decommissioning, the licensing branch of the RB (the pdNIV) performs the assessment in cooperation with the Ministry of Finance.

11.2 Human resources

11.2.a Legislative aspects

The Nuclear Energy Act stipulates that an application for a licence must contain an estimate of the total number of employees plus details of their tasks and responsibilities and, where applicable, their qualifications. This includes supervisory staff. The relevant regulations referenced in the licence of Borssele NPP are NVR NS-G-2.8 (Dutch application of IAEA NS-G-2.8) and the specific Safety Guide NVR 3.2.1 for control room personnel.

The safety relevant part of the organisational structure of the plant is described in the Technical Specifications, with clear details of the responsibilities, authority interfaces, lines of communication, requisite level of expertise, and the requirements for training and education. It is therefore part of the licence, and hence subject to inspection by the RB. Another part of the licence is that any planned organisational change with possible safety relevance, must on forehand be reported to the authorities.

Under NVR-NS-G-2.8 the responsibility for ensuring that individuals are appropriately qualified and remain so rests with the operating organisation. It is the responsibility of the plant manager, with reference to each position having importance to safety to ensure that:

- The appropriate qualification requirements are established;
- The training needs are analysed and an overall training programme is developed;
- The proficiency of the trainee at the various stages of the training is reviewed and verified;
- The effectiveness of the training is reviewed and verified;
- The competence acquired is not lost after the final qualification;
- The competence of the persons occupying each position is periodically checked and continuing training is provided on a regular basis.

The LH has to submit its education and training plan for its control room staff to the RB for information and approval.

In 2009 the NVR 3.2.1 for control room personnel has been changed with respect to the former 60-years limit of the age of control room personnel. Now the qualification is based on performance.

11.2.b Training and qualification of EPZ staff

The Borssele NPP has a training department that is responsible for: maintaining the personnel qualification register, qualification activities, coordination of training activities, training records keeping, and delivering of in-house developed training courses; and organizing training courses that are delivered by contractors. For conduct of the in-house developed training, subject matter experts are

extensively used. Training responsibilities for conduct of practical (on-the-job) training are distributed among respective plant departments.

Training and personal development programmes are developed based on competency analysis and consequent training matrix for each job position. Nuclear safety, ALARA principles, industrial safety, operating experience (domestic and international) are included and re-enforced during general employee training, during conduct of initial training programmes and during refresher courses. Training programmes are structured to cover required theoretical knowledge, practical training and on-the-job training. Training material for the basic course is under QA review scheme.

Control room operators, emergency support staff and several others use the full scope, plant specific training simulator. This simulator is based in the simulator school in Essen (Germany). Training is given by professional teachers of the simulator school.

The simulator dates from 1996 and reflects the then state-of-the-art in nuclear training simulators.

Both the recent WANO Peer Review and the preliminary results from the ongoing PSR (to be finished in 2013) show that both its scope and fidelity shoud be enhanced to meet the current state-of-the-art.

The contracted staff for running the simulator training programme is of appropriate size and comparable to general industry practice.

External organizations are extensively used for delivering training. For specialized training on specific equipment vendor facilities are used. For safety related subjects, equipment vendors or recognized institutions in the nuclear field are used, for example Westinghouse, Framatome, WANO, and NRG[42].

Training on emergency preparedness is conducted regularly. The plant has a dedicated desktop simulator for emergency excercises, including core melt scenarios for training on SAMGs. Individuals having the position of Site Emergency Director attend position specific training and once per year a simulator retraining course together with one shift team. Large scale emergency exercises are supported also by training on the full scope simulator. In relation to the Complementary Safety Assessment (CSA) or ‘stress test’, competence, availability and sufficiency of the staff required for severe accident management is being assessed, including contracted personnel or personnel from other nuclear installations. Improvements to training programmes are being made as a result of among others new insights from the CSA, periodic safety reviews (PSR), operational experience, development of training methods and practices.

Additionally, every year on average five staff members of EPZ are involved in WANO, OSART, AMAT and other similar missions. One EPZ-employee is seconded to the WANO Paris Centre.

Observations regarding the number of staff employed after the reorganisation in 2005 can be found in section 12.6.

[42] Nuclear Research and consultancy Group, Netherlands

Training facilities
A replica full scope simulator, located at the training centre KSG&GfS near Essen in Germany, is used for training of the Borssele plant personnel. The training is given in Dutch. The annual retraining programme for operations control room personnel is developed corresponding to a 5-year training plan. Learning objectives are developed based on competences and operational feedback (communication skills). Additional topics are added based on operations management inputs and feedback from trainees. Operators attend two weeks of on-site training where one part is on plant modification (just before outage) and the second part is on applicable portions of the annual refresher course. Both the training programme and the simulator need to be approved by the RB.

For shift team evaluation the plant developed a method for continuous evaluation based on 20 elements that are documented in each scenario exercise guide; results are followed for recognition of weak areas in performance and used for future attention.

The electrical and instrumentation training facility includes fully equipped classroom and separate rooms for practical (on-the-job) training. A high number of comprehensive mock-ups is available and most of them were developed in-house. Many mock-ups have capability to introduce malfunctions and are excellent tools for training on troubleshooting techniques.

The mechanical maintenance training facility, intended for on-the-job training is located inside the radiological controlled area. The inventory of mock-ups to train the most critical work sequences, especially from the ALARA standpoint, includes a steam generator bottom section, special valve types (disassembly/reassembly), part of reactor vessel and adjacent wall to train on replacement of rupture plate special seals.

Formal authorization before assigning certain persons
A formal authorization issued by the RB or by another body delegated or authorized by the competent authority is required before certain persons are assigned to a designated safety related position. According to NVR 3.2.1, control room operating personnel need to be in possession of a special licence. This is issued once the candidate has completed a specified period of training and passed an examination which is supervised by the RB. The licences are signed by the plant manager and co-signed by the director of the KFD. All training, education, examinations and medical checks of licensed personnel are documented.
There are three levels of control room licences that require renewal every two years:

- reactor operator;
- senior reactor operator;
- shift supervisor.

There is no difference between the qualifications required for operators working on the nuclear side and those working on the turbine side, as the policy is that operators should be fully interchangeable.

Instructions to plant staff on management of accidents beyond the design basis
For the management of accidents beyond the design basis an emergency plan is implemented and agreed with the authorities. Instructions from the emergency procedures are applied. From these are initiated for example the symptom bases procedures and the Severe Accident Management Guidelines (both originally from the Westinghouse Owner's Group). In addition the emergency staff in case of an incident can use the software package WINREM which features a reliable model for the dispersion of radioactivity and the calculation of the potential consequences of accident releases.

Assessment method of qualification and training of contractor's personnel
At EPZ qualifications of the contractors depends on their job or area they have to work in. Independent to their job or area, all the contractors are qualified for industrial safety by the VCA qualification. This is a general Dutch qualification for working in the industry. In addition to that, EPZ has its own qualifications for contractors, dependent on their job or area they are working. Examples

of these qualifications are electrical safety, nuclear safety and industrial safety. All these qualifications are passed by an examination. Besides that EPZ has a special qualification for work party leaders called Ziza. All the work party leaders and workers who work without supervision in the plant are specially qualified for this work. Qualifications of special craftsmen are part of the purchasing conditions and are controlled by the purchasing department.

11.2.c Assessment method of sufficiency of staff

The process of recruitment and selection of staff is managed so that it ensures enough qualified staff under all circumstances. Performing independent internal audits assesses this process. The regulator and the LH are considering the maturity of this approach.

11.2.d National supply of and demand for experts in nuclear science and technology

In the Netherlands, eduction in radiation protection, nuclear safety and nuclear technology is provided by several universities and other organisations. Education in nuclear technology at academic level is provided by the Technical University of Delft. Many companies applying nuclear technology provide in-company trainings.

At the moment there seems a balance between supply and demand. At times it may be difficult to find an expert with a certain number of years of relevant experience. But several companies also get quality staff from abroad.

11.2.e Supervision of human resources

Part of the surveillance program of the inspectorate of the RB is the subject of human recourses. The LH’s number of staff, their education, their training and their experience are being assessed.

ARTICLE 12. HUMAN FACTORS

12. Each Contracting Party shall take the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation.

12.1 Introduction

Human Factors (HF) are all those factors where the interface between humans and technology plays a role. They consist basically of two elements: internal factors such as talent, competence, professional skills, motivation, stress resistance and situational flexibility, and external factors such as work environment, actual and potential process control, procedures, training and education, accessibility of components and automation. The emphasis in the design of man-machine interfaces is on the external factors.

Although man-machine interfaces have always played a role in the design and operation of complex machinery such as nuclear power plants and aircrafts, it is only in recent decades that they have become part of the evaluation and attention processes and as such are widely recognised. With the development and performance of PSAs, systematic data collection and structural modelling have become part of the process of evaluating Human Factors.

12.2 Legislative aspects of HF

Human Factors play an important role in nuclear safety. The Dutch rules and guidelines (NVRs) referenced in the licence of Borssele NPP – especially those in the Management System and Operation series – do take account of Human Factors, as do the original IAEA Codes and Safety Guides.

Since the NVRs are part of the licence, the LH is required to give full consideration to Human Factors.

12.3 Methods and programmes for human error

The evaluation method to be used when inspecting and assessing the influence of Human Factors on incidents needs to be based on a well-proven systematic approach. The method being used since 1992 by the Dutch LHs and the Regulatory Body (RB) is the original American method known as the HPES (Human Performance Enhancement System).

To improve the results on human performance, the plant has started a Human Performance program that covers the following subjects:

- Embed the organizational aspects of Human Performance in daily operations;
- Create, communicate and reinforce Management Expectations, including the use of Human Performance tools;
- Improve effectiveness of management in the field;
- Perform and improve Human Performance initial and refresher training courses;
- Development of a work practice simulator.

The Human Performance program will be executed in the years 2013 and 2014.

The plant has dedicated modules on Human Factors in its initial and refresher training courses.

A work praktice simulator is under development, planned to become operational early 2014.

12.4 Self-assessment of managerial and organizational issues

Apart from the assessments of the impact of proposed operational or design changes on safety or the periodic safety reviews, which are both regulatory and institutionalised requirements, the LH regularly performs self-audits, or requests audits or peer reviews by others in order to evaluate its own operation. In particular the Organizational, Personnel and Administrative aspects of operation are subjects for these audits and peer-reviews. The licence requires two formal types of self-assessment, to be reported to the RB:

- 2-yearly PSR;
- 10-yearly PSR.

Examples of this practice are the WANO-Peer Reviews in 2008, 2010 (follow-up) and 2012, as well as the organizational part of the SALTO in 2012 (required for LTO). At least every 4 years there will be a full scope WANO PR at the NPP. The next OSART mission is scheduled for the 2nd half of 2014. The LH has communicated its plan to increase the number of international missions to once in about three years.

An important aspect in the assessment of safety is the ability of the assessor to make use of the state-of-the-art. Therefore, experts of the LH participate in audit and peer-review teams of IAEA and WANO to evaluate other plants. The insights gained from these participations are used in their assessment work at Borssele NPP.

At Borssele NPP, the internal safety review of technical and organisational modifications is organised as follows:

- *Technical*: All aspects of technical modifications relevant to safety are documented in a ‘Modification Plan’. This report is verified by all relevant specialists. After their comments have been taken into account, the report is independently reviewed by staff in the Safety Design Department. Once accepted by this department, the original report and the independent review report are sent to the Internal Reactor Safety Committee to advice the Plant Manager for authorisation. The last step in the review is an assessment under the authority of the RB. In the case of minor modifications likely to have no impact on safety, a simplified procedure is applied.
- *Organisational*: Proposals for organisational modifications are prepared by the Human Resources Management Department. The final proposal is outlined in a report describing the changes relating to the organisation (structure, tasks/responsibilities, systems, documents, staffing and potential associated impact on nuclear safety). The (internal) independent nuclear safety officer checks the final proposal against all the organisational requirements laid down in the licence, NVRs (amended IAEA codes and guides) and other relevant regulatory documents and produces a report on his findings. The two reports (the final proposal and the independent verification) are then reviewed by the internal and external reactor safety committees of the Borssele NPP before being submitted to the authorities

12.5 Human factors and organisational issues in incident analysis

At the Borssele NPP information on event reports and analysis results and near miss reports is accessible for everyone through the intranet. The categories ‘written procedures’ and ‘personnel work practices’ are causing most human errors. Lessons learned or corrective actions from operating experience can lead to corrections or enhancements of the work instructions or the lessons learned from individual events or trend analysis can lead to a toolbox meeting e.g. to raise the awareness about the human factor in events. For operations personnel, the feedback on operating experience is part of the yearly refresher training which is also attended by other people. Some statistical information

derived from the annual report, lessons learned and important external events are on the agenda of that training.

In the Netherlands, LHs address the subject of Human Factors in their annual reports. Good examples are the LHs of the Borssele NPP (LH: EPZ) and the High Flux Reactor in Petten, (LH: NRG, owner European Union).

12.6 Human factors in organisational changes

Several of the LHs are (or have been) engaged in processes of organisational change, often paralleling changes in their hardware. A significant reorganization was finished at the Borssele NPP in 2005. The reorganization meant to clarify the responsibilities; to shorten the management lines; to improve cross functional functions (particularly during outage); and anticipate and adjust the resources accordingly.

The reorganization process put some pressure on the relationship between management and employees. The main reason for this was the limited scale on which employees were involved. The management started a company culture programme and carried this out in 2007-2008 to improve this relationship.

Since 2006 - after the decision of the government to agree with operating until 2034 - the plant is preparing for the future with an increased number of programmes. It was noticed more frequently that staff shortages in several areas emerged. It also became apparent that management should spend more time to supervision to solve structural or longer lasting issues. The plant management took a number of steps to improve the situation:

- Improvement of the lack of resources;
- More proactive resources planning
- More delegation to improve management availability to lead and supervise;
- More involvement of and communication with all staff.

12.7 Fitness for duty

In the Netherlands there are several laws that regulate the protection of the health and safety of employees. Examples are the law on working hours (‘Arbeidstijdenwet’) with the aim to keep personnel fit for duty and a specific law focused on a safe and healthy work environment (‘Arbo-wet’).

The nuclear safety rules require specific medical tests:

- Under NVR 3.2.1, control room operating personnel need to be in possession of a special licence. This is issued once the candidate has completed a specified period of training and passed an examination and medical test. The medical test is repeated every twelve months.
- Under NVR-NS-G-2.7, all site personnel who may be occupationally exposed to radiation at the nuclear power plant shall be subjected to an initial and to periodic medical examinations as appropriate.

The management of the Borssele NPP in 2009 introduced alcohol and drugs test.

12.8 Supervision

Human factors and organizational issues related to safety have become more important subjects in all types of industries, including the nuclear industry. Organizational issues and human factors are getting the attention of KFD in relation to work preparation, composition of teams, work execution, internal communication, process control and incident analyses.

The inspectorate brance of the RB, the KFD, is closely following the organisational changes within the organisation of the LH.

ARTICLE 13. QUALITY ASSURANCE

13. Each Contracting Party shall take the appropriate steps to ensure that quality assurance programmes are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the life of a nuclear installation.

13.1 Introduction

The quality assurance programmes originally formally introduced at the nuclear installations in the Netherlands were based on the first IAEA Safety Series on QA. They have since been modified in line with international developments. A description of the initial period, the development of the programmes and cooperation between the parties involved was given in the Netherlands' first and second national reports on compliance with the Convention on Nuclear Safety.

In the nuclear sector, there has been a change of policy in the form of a shift from simply complying with a set of rules towards performance-based Quality Management Systems (QMSs) accompanied by processes of continuous improvement.

The importance of good safety management at nuclear installations is well recognized in the Netherlands. The aim of safety management is to formulate good safety policies for the relevant installation and this includes ensuring that the reasons, effects and consequences of those policies are communicated downwards to every level in the organization.

13.2 Regulations

The rules and guidelines on quality assurance used by the Regulatory Body (RB) in the Netherlands are still based on the requirements and safety guides in the IAEA Safety Series (50-C/SG-Q), where necessary amended for specific use in the Netherlands. They are implemented as a Ministerial Order. Separate from this, since 2011 relevant and updated NVRs are attached to the licence of the NPP, like NVR-GS-R-3, NVR-GS-G-3.1 and 3.5. More about the update can be found in section 7.2. (i).

13.3 The integrated management system (QMS) at the Licence Holder

The managementsystem at the LH has been in place more than 20 years. The system is being renewed and will be made in comply with the latest international requirements (GS-R-3) and guidelines.

The quality management programmes at the nuclear installations were originally based on the old Dutch NVRs and were subject to regular audits by the RB. Together with the LHs' self-assessment activities, they gave the RB a good insight into the current state of affairs. As from 1998 onwards, the Borssele NPP is the only operating nuclear power plant in the Netherlands and as such the main focus of attention of the RB with respect to Quality Management Systems.

Over the last few years, the policies and elements of the revised IAEA QA Safety Series have been introduced in close consultation and cooperation with the management of this plant. Performance-based quality assurance has required a modification of the plant's written processes and instructions, together with a change in attitude on the part of management and staff. The use of critical success factors and of performance indicators has led to a process control based on more quantitative criteria. The interfaces with safety culture and safety management have added to the complexity of the introduction of the new QMS.

The interface of the QMS with Human Factors is important too. One aspect is the minimum staffing level for the various sections of a LH's organisation.

Specific attention also needs to be paid to the subject of outsourcing. Criteria for what is acceptable in this area appear to differ very widely in the various countries of the OECD/NEA. Some countries like the Netherlands have at present almost no specific official criteria. Others have made provisions in general terms or even have defined specific regulations or guidelines to manage outsourcing. International cooperation and exchange of knowledge and experience may lead to a better understanding of these problems in the near future, which may lead to a set of criteria and/or regulations for the Netherlands.

The long term operation of the Borssele NPP has prompted the LH to plan for the transformation of the QMS into a genuine Safety Management System (SMS)..

13.4 Supervision of the management system by the Regulatory Body

The inspections by the inspectorate branche of the RB (the KFD) are also covering the QMS of the LHs. Most of the nuclear installations in the Netherland are of a relatively high age. Due to this fact more attention has to be given to subjects as ageing and the assessment of the effectiveness of maintenance programs in use, in addition to the classical QMS approach.

ARTICLE 14. ASSESSMENT AND VERIFICATION OF SAFETY

14. Each Contracting Party shall take the appropriate steps to ensure that:

i. **comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the Regulatory Body;**

ii. **verification by analysis, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and operational limits and conditions.**

14.(i) Assessment of safety

Regulatory requirements

In the Netherlands, a licence is needed for the construction, operation or modification of a nuclear installation. Such a licence is only granted if the applicant complies with (among others) the siting requirements, NVRs on Design, Operation etc. (see Appendix 4) and with the probabilistic safety criteria. These criteria include dose-frequency constraints within the design-basis envelope. Appendix 1 gives a detailed overview of the probabilistic safety criteria.

The NVRs are fairly general and lack the technical detail found in national nuclear regulations of some other countries. In addition there are no nationally developed nuclear codes and standards in the Netherlands. Therefore additional material is needed to define the licensing basis. This includes parts of e.g. the US Code of Federal Regulations, the US NRC Regulatory Guides, the US NRC Standard Review Plan, the ASME code, the ANS/ANSI standards, KTA standards, and RSK recommendations. These documents have no formal status in the Netherlands. The NVRs require the applicant to specify and defend the technical basis and industry standards he is going to use. In this process, the Regulatory Body (RB) expects the applicant to demonstrate that:

- the chosen set of foreign regulations and industry standards are consistent with the relevant NVRs;
- if more than one set of standards or regulations is to be applied, the various sets should be consistent.

The section on Article 7 gives a more comprehensive overview of the applicable legislative framework.

To support his licence application, the LH shall draft (among others) a Safety report (SR) and a Safety analysis report (SAR), which he shall submit to the RB with the application. The SR is the report that is attached to the licence, and as such it is a public document. It describes the organisation, the design, the outcomes of the safety analyses, etc. into some detail. The SAR gives a more detailed description of the proposed facility and presents an in-depth analysis of the way in which it complies with the NVRs. Its claims are supported by detailed descriptions of the safety analyses, simplified system diagrams, and other supporting documents. To illustrate the difference between SR and SAR: the Borssele NPP SR is a two-volume document, whereas the associated SAR is a twenty-volume document. Both documents are updated with each modification of the installation.

The SAR is supported by a Probabilistic Safety Analysis (PSA), comprising levels 1, 2 and 3 (see Appendix 3). The PSA – in particular the level-3 part of it – is needed to demonstrate that the facility meets the probabilistic safety criteria as laid down in the regulations (Bkse, see section on Article 7).

Review by the Regulatory Body
The RB (mainly the inspection branch, the KFD) studies the SAR in depth. The underlying and supporting documents are also reviewed in depth to ensure that the regulations have been met. In the review process, selected items are analysed with computer codes other than have been used for the original analyses provided by the LH. Often, assessments of similar power plants performed by a foreign regulatory body are also considered.

Since the KFD is a small organisation, it often seeks the help of Technical Support Organisations (TSOs) like GRS, AVN and TÜV.

The KFD has asked the IAEA to provide support to ensure the proper assessment and review of PSA results. The IAEA has undertaken peer reviews of the PSAs (the IPSART missions, formerly known as IPERS missions) and has given training courses in PSA techniques and PSA review techniques. Appendix 3 provides further information both on the role of the PSA in relation to safety assessment and on the associated regulatory review and guidance.

Once the reviews and regulatory assessments have been completed and it has been established that the applicant is acting in accordance with the rules, regulations and radiological safety objectives, the licence can be granted. The main elements of the assessment are documented, as required by the RB's internal QA process.

Periodic Safety Reviews (PSRs)
Since about 20 years one of the conditions of the licence is that the safety of the nuclear installation is to be periodically reviewed in the light of operating experience and new safety insights. Since 2011 also the EU-directive on nuclear safety is applicable which contains a similar requirement. A review of operational safety aspects must be performed once every two years, whilst a more comprehensive safety review must be conducted once every 10 years. The latter involves a review of the plant's design basis in the light of new developments in research, safety thinking, risk acceptance, etc. The policy on back-fitting was first formulated in 1989 ('Policy Document on Backfitting'). It should be noted that this policy has not been formally adopted, but is used by the RB as guidance and has been accepted by the LH. In 2010 the NVRs were updated. Then also a new NVR on PSR came into force, based on the corresponding IAEA safety standard. The idea's of the 1989 document are fully covered by the IAEA document. Also the adopted WENRA policy on PSR is a further guidance today.

First 10-yearly Periodic Safety Review
In the late 1980s, mainly as a result of the Chernobyl accident, the Dutch government formulated an accident management and back-fitting policy for the two NPPs in operation at the time. Both utilities were asked to upgrade the safety of their plants by incorporating state-of-the-art features and investigations of possible ageing, and hence to guarantee safe operation in the next decade. With the aid of the respective reactor suppliers, the two utilities developed a new safety concept for their plants in the early 1990s. The safety issues were very much related to lack of separation, lack of redundancy and lack of resistance against external events. This first formal ten-yearly safety evaluation of the Borssele NPP has resulted in the MOD-modification project. This project, which was concluded in 1997, has led to a level of safety that complied with the current risk standard of the Dutch government. For this purpose, major investments have been made, mainly for spatial separation of redundancies (mostly concerning design aspects) and to a lesser extent for Organisational, Personnel and Administrative (OPA) provisions.

In Appendix 5 of this national report of the Netherlands, a detailed description is given of the modifications of the Borssele NPP resulting from this first 10-yearly periodic safety review.

Second 10-yearly Periodic Safety Review
In the beginning of 2004 a second ten-yearly safety review of the Borssele NPP was finalised. It included a safety evaluation of the period 1993-2002, the drawing-up of proposals for adaptations of the technical, organisational, personnel and other provisions to achieve state-of-the-art conformity, as well as the implementation of the proposed measures. This second ten-yearly safety review results in a fine-tuning of the safety concept of the plant rather than major changes.

Specific attention in this safety review was paid to:

- International developments and views relating to e.g. back-fitting programmes and other reactor designs;
- Ageing, including selection of the Structures, Systems and Components to be reviewed and ageing management;
- State-of-the-art PSA analyses;
- Evaluation of good practices;
- Safety analyses with respect to external conditions;
- Accident management and severe accidents;
- Fire protection.

In Appendix 5 an overview is given of the most important technical, organisational, personnel and administrative measures due to the evaluation. Some measures were implemented in a slightly different but agreed way due to increased understanding of processes and phenomena in the phase of detail-engineering.

Third 10-yearly Periodic Safety Review and Long Term Operation
According to the licence the LH must issue a third 10-yearly safety review at the end of 2013. The present Safety Report contains a statement that the design of the plant is based on an operating period of 40 years starting from 1973. Therefore the LH had to apply for a licence approving Long Term Operation (LTO) supported by sound evidence that the plant can be safely operated for a longer period. It was decided between the RB and the LH not to combine the two subjects but to execute two complementary projects, each having its own time frame. The LTO project resulted in a licence application that was submitted for regulatory review in 2012.

The LTO project covers among others:
- The so called preconditions referenced in IAEA Safety Report Series 57, like adequate programs for maintenance, in-service inspection, surveillance, chemistry and equipment qualification;
- The assessment of design calculations and safety analyses containing time related (40 years) assumptions;
- The ageing assessments and ageing management programs;
- A number of non-technical issues in the area of organisation, administration and human factors.

Since there was a certain overlap with the 3rd PSR it was decided that two safety factors (SF10 Organisation, Management System and Safety Culture and SF12 Human Factors) assessed in the PSR-project shall be part of the LTO-licensing application.

The LTO process was supported by one limited scope IAEA SALTO mission in 2009, with the aim to see if the LTO-programme and approach was comprehensive and according to the state of the art. At the end of the LTO programme and in the phase of the licensing a full scope SALTO mission was carried out in May 2012, covering also the follow up on the mission in 2009. The final LTO-licence was given in March 2013, including the provision to complete the measures based on the SALTO mission recommendations before the end of 2013. In February 2014 the follow up of the SALTO mission will be carried out. In Appendix 8 the recommendations and measures, including the status are listed.

During the third PSR amongst others the following is relevant:

- DS426, update version of IAEA NS-G-2.10 will be used as guidance
- A benchmark study of PWR's of the same age and with LTO
- A benchmark study of the EPR (including Finnish regulations) and AP1000
- Study of the 2010 WENRA document "Safety objectives for new reactors"
- Modernization of deterministic safety analyses
- Lessons learned Fukushima Daiichi accident
- Use of PSA to determine potential safety improvements

Comprehensive safety analysis following the Fukushima Daiichi accident (Ensreg stresstest)
The European stresstest has been carried out in 2011 and was peer reviewed on at European level in 2012. In the middle of 2012 the RB in agreement with the LH requested to implement a set of measures according to a detailed schedule. The measures and the planning have been published in the National Report on the 2nd extraordinary CNS in 2012. These measures are not considered the final improvements based on the lessons learned from the accident, because more information will become available in the future. More details about the implementation of the measures (status 1-4-2013) are:

- Robust emergency response center; the location is still open either onsite or offsite; specifications have been drawn up; current study aims at realization within the current Waste storage facility. Usability of this building depends on the robustness of this building against earthquakes and the severity of the earthquake that has to be considered for the site.
- Station blackout while in midloop operation, improve the emergency injection from the buffertanks (discussed during the Country Peer review); in the meantime a formal instruction has been written and will be implemented in April 2013 after testing at the plant simulator and training. Further study will be conducted to determine if the motor operated valves can be operated by connecting them to one of the emergency power sources.
- Shutdown of the emergency oilpump from the turbine to improve the battery capacity; it is clear now that within about an hour after the turbine trip due to emergency power the oilpump can be shutoff; the increase of battery time is 3 hours (from 2,8 to 5,8 hours); other improvements will increase the battery time 1,9 hours more (from 5,8 to 7,7 hours).
- Seimic acceleration detectors; it has been decided in agreement with the Royal Meteorological Institute (KNMI) to install two detectors, one in a building and the other in the free field and both provided with Uninterupted Power Supply systems. Implementation is expected in June 2013.
- Study flooding/superstorm is ready. This report learns that the maximum flood level with superimposed waves is lower than the design flood level of the plant. As the plant is already designed according to a higher flood level than the most recent requirements, additional margin has been 'gained' and extra measures to increase the margin even further are not selfevident.
- Measure to fill the wet fuel pond, without entering the containment building has been implemented; one of the actions is to connect two systems with a 30 meter fire hose.
- The measure to reduce the time to connect a large mobile diesel generator to just 2 hours has two parts: the time to move the generator to the spot (implemented) and the time to connect it.
- A first batch of mobile equipment has been bought and stored in the on-site waste storage building; the emergency response plan will be adapted; there is no decision about the new emergency control center yet.
- Airplane crash: study is going on to determine the required activity based on international insights, experience and guidance.
- Increase of autharky time: a modification proposal has been developed. A more detailed study to assess the feasibility of the proposed increase will be performed but has not been started yet.

- Seismic Margin Analysis (SMA): the analysis is in progress; new information from studies has revealed that the PGA at the NPP site might be larger than earlier expected. Discussions about the applicable earthquake level are ongoing.
- Reinforcement of external power supply: proposal is under review. Decisions on the measures to be taken have not been made yet.

More details and further updates of the implementation will be presented at the CNS in 2014.

Safety Assessments related to modifications
Significant changes to the installations that imply changes to the design assumptions, as laid down in the safety report, require a licence. New safety analyses have to be performed to demonstrate that the safety impact of these modifications remain within the prescribed limits. An example of a change requiring a safety analysis is the following.

In the late nineties the safety report and some safety analyses were updated when the LH of the Borssele plant submitted a request for a modification of the licence in order to be able to use higher enriched fuel elements (from 3.3% up to 4%). External experts were consulted for the review. There was special emphasis on issues associated with high burn-up fuel in relation with prevention of reactivity insertion accidents (RIA-accidents). The review was repeated at the end of 2003. A modification of the licence was requested to use 4,4% enriched fuel and a burn-up limit for fuel rods averaging 68 MW day/kg U by using the new Niobium-Zirconium cladding material M5 (Framatome) with an improved corrosion behaviour. Up to now the average burn-up of the fuel never exceeded 60 MW day/kg U due to the constraints (heat, radiation) imposed by the specifications of the spent fuel containers. The power plant shall provide additional tests of the fuel quality before going from 60 to 68 MW day/kg U for the whole core.

In 2010 a licence application was sent to the RB for the introduction of MOX-fuel. The MOX-licence became irrevocable in 2013. The first reload is expected in 2014.

In the near future it is expected that a decision will be made about the digital I&C. Even if this could be carried out within the licence boundary as a plant modification this will be a large review project.

Safety assessments initiated by the LH or RB – audits and peer reviews
Apart from the assessments of the impact of proposed operational or design changes on safety or the periodic safety reviews, which are both regulatory and institutionalised requirements, the LH regularly performs self-audits, or requests audits or peer reviews by others in order to evaluate its own operation. Also the regulator may request a peer review. In particular the Organizational, Personnel and Administrative aspects of operation are subjects for most of these audits and peer-reviews. Examples of this practice are the WANO-Peer Reviews in 1999 and 2008 (see Article 10) and a second OSART mission to the Borssele NPP in 2005. At least every 10 years there will be an OSART mission at the NPP. The WANO peer review frequency has been increased to once in 4 years after the Fukushima Daiiche accident. The most recent missions were IPSART 2010/IPSART Followup 2013, SALTO limited scope mission 2009/fullscope mission 2012/followup in 2014, WANO-Peer review 2012. In Appendix 8 the main findings of these missions are listed. In February 2014 the SALTO followup mission will take place. The results of planned missions will be reported at the CNS 2014.

Review by the Regulatory Body
The licensing branch of RB studies the SAR in depth. The underlying and supporting documents are also reviewed in depth to ensure that the regulations have been met. In the review process, selected items are analysed with computer codes other than have been used for the original analyses provided by the LH. Often, assessments of similar power plants performed by a foreign regulatory body are also considered. Once the reviews and regulatory assessments have been completed and it has been established that the applicant is acting in accordance with the rules, regulations and radiological safety

objectives, the licence can be granted. The main elements of the assessment are documented, as required by the RB's internal QA process.

Supervision by the RB
After a licence has entered into force in principle the supervision branch of the RB (the KFD) takes care of the implementation review and control. This means in practice that the LH is required to send detailed documentation about safety relevant modifications which will then be reviewed before final implementation. During implementation inspections are carried out. KFD supervises for instance the implementation of the stresstest measures, the MOX licence, the LTO-licence and after 2013 the improvements from the 3rd PSR. Since the KFD is a small organisation, it often seeks the help of a Technical Support Organisation (TSOs) like GRS. But also support by IAEA is used.

The KFD has for instance asked the IAEA to provide support to ensure the proper assessment and review of PSA results. The IAEA has undertaken peer reviews of the PSAs (the IPSART missions, formerly known as IPERS missions) and has given training courses in PSA techniques and PSA review techniques. Appendix 2 provides further information both on the role of the PSA in relation to safety assessment and on the associated regulatory review and guidance.

14.(ii) Verification by analysis, surveillance, testing and inspection

In general, the LH is responsible for inspecting and testing all NPP equipment and systems in order to guarantee their safe operation.

EPZ performed an LTO assessment to justify safe operation with NPP Borssele until 2034. In this LTO assessment a specific verification of the existing 5 plant programmes (maintenance, surveillance, in-service inspection, chemistry and equipment qualification) was performed. It could be shown that the 9 attributes according to IAEA Safety Report 57 are adequately fulfilled in the programmes.

The regulatory authority checks that the inspection and test programme is adequate for this purpose.

The LH has also adopted the FLEX concept. In this concept on-site mobile equipment can be used for different tasks following the instructions of the so called FLEX Support Guidelines (FSGs). The FSGs provide pre-planned FLEX strategies for specific tasks under beyond design basis conditions. FSGs support the existing EOPs and SAMGs but they do not replace them. Together with the mobile equipment they form a beyond design extension of the existing plant. The decision making and the command and control for the event stays within the existing EOP and SAMG structure. Some adjustments will be made to the EOPs and SAMGs to make entries into the FSGs.

EDMGs are procedures to regain command and control of an event when the execution of the EOPs and SAMGs is not possible due to extensive damage e.g. when the main control room and the on-site shift personnel have been lost. This means that EDMGs are focused on the deployment of the Emergency Response Organization under the most adverse circumstances. As soon as the ERO regains command and control of the event the EOPs, SAMGs and FSGs will be used to manage the situation.

The LH will extend the existing EMDGs with:

- guidance to notify and deploy ERO staff (including shift personnel) under adverse conditions;
- guidance for on-site and off-site communications under adverse conditions;
- guidance on initial Operational Response Actions;
- guidance on initial damage assessment.

The LH will develop FSGs to:

- use mobile pumps for different purposes;
- use mobile generators.

The relevant NVRs are NVR-NS-G-2.6 (Maintenance, Surveillance and Inspection) and NVR-NS-G-2.1 for fire protection. In addition, the licence requires that the Borssele NPP has an ageing management system for all structures and components important to safety, so as to enable plant management to take appropriate action in good time. A specific department at the Borssele NPP reviews information on ageing of structures and components. This includes internal information (maintenance, in-service inspection etc.) and external information (event reports on ageing, direct information from other plants etc.). This ageing experience feedback programme operates in addition to the existing programmes involved in ageing management (in-service inspection, maintenance, chemistry monitoring etc.).

Based on the results of a comprehensive Ageing Management Review performed in the LTO assessment, EPZ is further improving the existing ageing management process by introducing a specific procedure on ageing management of passive structures and components important to nuclear safety in the plant. This procedure is owned by the aforementioned department and is particularly important to improve coordination and traceability of ageing management activities. NVR-NS-G-2.12 is the basis for this procedure. Using this procedure, several recommendations from the LTO Ageing Management Review will be implemented.

The assessment and inspection of the integrity of pressure retaining components is subcontracted to a Notified Body, Lloyds Register Nederland BV. The assessments and inspections of the Notified Body are performed under supervision of the KFD. Refer to section 7.2(i) for recent developments with respect to these types of inspections.

The KFD conducts regular inspections and audits to check the other inspection and test activities at the power plant. [open: beschrijving van de reactorvatmetingen en de resultaten van deze metingen van April 2013] Deze informatie kan waarschijnlijk worden aangevuld in de eerste helft van mei.

The current licence of the Borssele NPP includes a requirement for a Living PSA (LPSA). The reason for this is that the RB recognises an LPSA as being a suitable and sufficiently mature instrument of analysis to support certain aspects of safety-related decision-making in matters of design or procedures. These LPSA applications can reveal the effects of apparently insignificant changes in design or operating procedure. The requirement in the licence is qualitative. It means that the PSA must reflect the latest configuration of the plant and that the PSA must be used by plant staff when making safety-related decisions. In that respect, the NPP uses a risk monitor, e.g. for configuration control during outages.

An important aspect in the assessment of safety is the ability of the assessor to make use of the state-of-the-art. Therefore, experts of the LH participate in audit and peer-review teams of IAEA and WANO to evaluate other plants. The insights gained from these participations are used in their assessment work at Borssele NPP.

At Borssele NPP, the internal safety review of technical and organisational modifications is organised as follows:

- Technical: All aspects of technical modifications relevant to safety are documented in a ‘Modification Plan’. This report is verified by all relevant specialists. After their comments have been taken into account, the report is independently reviewed by staff in the Safety Design Department. Once accepted by this department, the original report and the independent review report are sent to the Internal Reactor Safety Committee to advice the Plant Manager for authorisation. The last step in the review is an assessment under the authority of the RB. In the case of minor modifications likely to have no impact on safety, a simplified procedure is applied.
- Organisational: Proposals for organisational modifications are prepared by the Human Resources Management Department. The final proposal is outlined in a report describing the changes relating

to the organisation (structure, tasks/responsibilities, systems, documents, staffing and potential associated impact on nuclear safety). The (internal) independent nuclear safety officer checks the final proposal against all the organisational requirements laid down in the licence, NVRs (amended IAEA codes and guides) and other relevant regulatory documents and produces a report on his findings. The two reports (the final proposal and the independent verification) are then reviewed by the internal and external reactor safety committees of the Borssele NPP before being submitted to the authorities.

ARTICLE 15. RADIATION PROTECTION

15. Each Contracting Party shall take the appropriate steps to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits.

15.1 Radiation protection for workers

Current legislation

As stated in the section on Article 7, the basic legislation on nuclear activities in the Netherlands is the Nuclear Energy Act. A number of Decrees have also been issued, containing more detailed regulations based on the provisions of the Act. The most important Decrees in relation to the safety aspects of nuclear installations and the radiological protection of workers and the public are:

- the Nuclear Installations, Fissionable Materials and Ores Decree (Bkse); and
- the Radiation Protection Decree (Bs).

These Decrees are fully in compliance with Council Directive 96/29/Euratom establishing basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation.

Bkse requires the Licence Holder (LH) of every nuclear power plant to take adequate measures for the protection of people, animals, plants and property. Article 31 of Bkse states that a licence must contain requirements aimed at as far as possible preventing the exposure and contamination of people, animals, plants and property. If exposure or contamination is unavoidable, the level must be as low as is reasonably achievable.

Bkse also states that these activities must be carried out by or under the responsibility of a person judged by the Regulatory Body (RB) to possess sufficient expertise. This expert must occupy a post in the organisation such that he or she is able to advise the management of the NPP in an adequate way and to intervene directly if he or she considers this to be necessary.

Written procedures must be available to ensure that the radiological protection measures that have to be taken are effective and to ensure that the aforementioned expert is properly informed. Full details of these conditions are given in the Radiation Protection Decree (Bs), which also lays down more specific requirements for the protection of people and the environment from radiation.

In conformity with the Euratom basic safety standards, the Radiation Protection Decree stipulates a limit of 20 mSv per annum as the maximum individual effective dose for radiological workers. In practice, no cases have been recorded which exceeded the 20 mSv per annum standard. If a problem should occur, there is an article in the Radiation Protection Decree that permits a higher dose in exceptional situations subject to stringent conditions. To date, the nuclear installations in the Netherlands have never experienced such a situation.

Implementation by the Licence Holder of Borssele NPP, EPZ

The LH has set a dose constraint of 6 mSv per annum as the objective for the individual effective dose limit for radiological workers at the Borssele NPP. The LH furthermore applies a 5 years average of 3 mSv per annum. This means that a radiological worker who receives a dose of 7 mSv during a particular year should receive less during subsequent years, until his average dose (averaged over 5 years) is no higher than 3 mSv per annum.

The average effective individual dose for both in-house personnel and externally hired personnel at the Borssele plant has shown a decreasing trend since 1983. The average effective individual dose over the last two years has been about 0.5 mSv per annum. Over that period, the trend in the collective dose has been very similar to that of the individual doses. In the early eighties, the total collective dose amounted to 4 manSv per annum. Over the two decades it decreased to about 0.3 manSv per annum. See Annex 1 for details.

Since 2009 the collective dose is rising due to the many extra activities and monitoring that are needed due to the LTO programme. Executing the LTO Programme is essential to keep satisfying the requirements imposed by the RB on the ageing NPP. In 2010 the total collective dose was about 0.6 manSv. In 2011 and 2012 the collective dose was about 0.3 manSv, but in 2013 a collective dose of 0,6 manSv is foreseen. Refer to Appendix 5 for more details.

One of the conditions of the licence issued to the Borssele NPP is that the manager responsible for radiation protection should be adequately qualified. The person in question is also required to hold a sufficiently independent position in the organisation to allow him to advise the plant or site manager directly on all matters of radiation protection. A precise description of the requirements for this manager's qualifications, as well as the qualifications which a number of other radiation protection officers need to possess, is given in the Technical Specifications (TS). The appropriate training programme covers the qualifications of the other officers.

Personal dosimetry records
Article 90 of the Bs Decree[43] requires that the operator records doses incurred by each exposed worker using personal dosimetry. Regarding personal dosimetry no distinction is made between Category A and category B workers. Only dosimetry services approved by the Ministery of Social Affairs and Employment (SZW) are allowed to provide dosimeters, to assess the received dose and to manage the dose records of exposed individuals.

Dose summaries of all dosimetry services are made available to the National Dose Registration and Information System (NDRIS). NDRIS has been established in 1989 by the Ministry of SZW. The main objectives of NDRIS are to preserve dosimetric data for the period required by the Euratom Basic Safety Standards and to bring together all data from all registered radiation workers, including those of foreign workers whose data are identified through the radiation passport.

NDRIS is managed by NRG, department of Radiation & Environment. In the beginning only data from individuals employed at institutes which had subscribed to the dosimetric services of NRG (and its predecessors) were collected but gradually also data from other approved dosimetric services were added. In 1994 and 2002 respectively, NDRIS was extended with data from external workers and with data from aircraft crew. NDRIS generates statistical data with the following features:

- personal data;
- social security number;
- dosimetric data;
- branch of industry (e.g. hospitals, nuclear industry);
- job category (e.g. veterinary X-ray diagnostics, radioactive waste treatment).

NDRIS is designed to process the collected data, to make statistical analyses of the recorded doses and to present various cross-sections for management purposes. It enables employers to collate information on occupational doses and to optimise operational radiation protection.

[43] Decree on radiation protection.

Reporting of worker doses
The current licence of Borssele NPP requires that the LH monitors, quantifies and registers all relevant radiological data. It also specifies the situations in which (and the terms on which) it must inform the RB. Another example of a 'radiation protection'-related requirement in the licence is the LH's obligation to monitor and record the radiation levels and levels of contamination at those locations where workers may receive an effective dose of 5 microSv or more in less than one hour.

Workers who work in places where there is a risk of internal contamination must be checked for this at least once a year. The results must be documented and kept for inspection purposes.

The LH is required to report to the RB every three months the individual doses received by workers who work at locations where they are exposed to an effective dose of at least 5 microSv in less than one hour. If a worker has received an effective dose exceeding 15 mSv within a period of three months, the LH must investigate all the circumstances that could have caused this dose level and must inform the RB of the results. These results have to be reported to NDRIS and are being kept in that system for at least 30 years.

The licence also requires the Borssele NPP to comply with the amended IAEA codes and Safety Guides (i.e. the NVRs). In the domain of radiation protection, Safety Guide NVR-NS-G-2.7 complements the requirements set by the Radiation Protection Decree (Bs), and lays down more specific requirements for:

- the lay-out of the controlled zones;
- the facilities within the controlled zones;
- staff qualifications and training; and
- the radiation protection programmes.

In order to comply with all the radiological conditions, the LH must have adopted adequate procedures for the implementation of such a radiation protection programme. The RB inspects the site to check the effectiveness of these procedures.

Prior to any reactor outage, the LH must give the RB an estimate of the anticipated collective dose. Once the outage activities have been completed, the LH must produce a dose evaluation report and inform the RB of the results.

If the anticipated collective dose relating to any job exceeds 10 man-mSv or the maximum individual effective dose is greater than 3 mSv, the RB will request the LH to produce an ALARA report showing that it has indeed taken the best possible radiation protection measures. The ICRP-60 publication is used as a guideline for this optimisation process. The criteria or considerations for submission of ALARA reports are based largely on a qualitative judgement rather than a quantitative assessment. The choice of the 10 man-mSv limit is pragmatic and is motivated by the legal difficulties concerning the definition of a specific job and the dose history associated with previous jobs.

15.2 Radiation protection for the public

The licence of the Borssele NPP requires the LH to comply with the amended IAEA Safety Guides (i.e. the NVRs). The Safety Guide NVR NS-G-2.7 'Radiation Protection and Radioactive Waste Management in the Operation of NPPs' complements the requirements set by the Radiation Protection Decree (Bs). More specific requirements are laid down in the Technical Specifications of the NPP. Also refer to Appendix 5, 'TECHNICAL DETAILS OF BORSSELE NPP'.

The monitoring of all discharges in air and water has to comply with the German regulations 'Sicherheitstechnische Regel des Kerntechnischer Ausschuss (KTA) 1503 and 1504'..The actual releases are normally less than 5% of the discharge limits (Appendix 5).

The design of the installation is the first step towards achieving the radiological safety objectives. The Safety Report (SR) must demonstrate that the design of the plant and planned operational conditions and procedures comply with these objectives. In addition, the radiation dose received by members of the public due to the operation of the NPP, including the discharges of radioactivity in water and air, must be controlled and optimised (ALARA) whenever the plant is in an operational state.

In article 48 of the Bs a source constraint amounting to one tenth of the annual effective dose limit for the population has been set for any facility. Both the LH (Borssele) and an independent institute (State Institute for Public Health and the Environment, RIVM) monitor the radiation levels at the border of the site continuously.

As prescribed in the licence, all discharges of radioactive effluents must be monitored, quantified and documented. The LH must report the relevant data on discharges and radiological exposure to the RB. On behalf of the RB, the National Institute for Public Health and the Environment (RIVM) regularly checks the measurements of the quantities and composition of discharges.

The LH is also required to set up and maintain an adequate off-site monitoring programme. This programme normally includes measurements of radiological exposures (with Thermo luminescence Dosimeters, TLDs) and possible contamination of grass and milk in the vicinity of the installation. The results are reported to – and regularly checked by – the Regulatory Body. Under Article 36 of the Euratom Treaty, each year, the discharge data must be submitted to the European Commission. The discharge data are also reported to OSPAR, the Convention for Protection of the Marine Environment in the North-East Atlantic.

Non radioactive materials and wastes are closely examined before release from the site, based on the rules in Bs and the licence. Radioactive waste is handled in accordance with Bs and the licence. The radioactive waste is sent to COVRA. The LH keeps records of the handled wastes and these will be regularly checked by the RB.

The framework for off-site nuclear and radiological emergency response, is described in the text under Article 16.

ARTICLE 16. EMERGENCY PREPAREDNESS

16.1 Each Contracting Party shall take the appropriate steps to ensure that there are on site and off site emergency plans that are routinely tested for nuclear installations and cover the activities to be carried out in the event of an emergency. For any new nuclear installation, such plans shall be prepared and tested before it commences operation above a low power level agreed by the Regulatory Body.
16.2 Each Contracting Party shall take the appropriate steps to ensure that, insofar as they are likely to be affected by a radiological emergency, its own population and the competent authorities of the States in the vicinity of the nuclear installation are provided with appropriate information for emergency planning and response.

16.1 Emergency plans

In this section, on-site and off-site arrangements are discussed in separate sections. The information about on-site issues is focused on the NPP Borssele.

16.1.a On-site: SAM

Regulatory framework

The Dutch Nuclear Energy Act sets the framework for nuclear safety management. Beneath this 'Decrees' provide for additional regulations, including provisions for licensing and requirements for risk assessments, and especially those for severe accidents.

The Regulatory Body (RB) can also issue 'Nuclear Safety Rules' (NVRs), the fourth tier in the regulatory framework (refer to the text on Article 7 about the regulatory framework). These have allowed the RB to attach international safety standards to the licence including WENRA Reference Levels (RLs) and IAEA Safety Requirements and Guides (via the NVRs). Some examples, highly relevant for on-site emergency preparedness, are:

- NVR NS-G-2.15 'Severe Accident Management Programmes for NPPs'
- NVR GS-R-2 'Preparedness and Response for a Nuclear or Radiological Emergency'
- NVR GS-G-2.1 'Arrangement for Preparedness and Response for a Nuclear or Radiological Emergency'

Licence condition 23 of the Borssele NPP requires the Licence Holder (LH) to establish and maintain an emergency plan and an emergency organisation, and also to ensure that exercises are conducted regularly. The on-site emergency plan and emergency organisation must be consistent with the off-site emergency planning as defined in the National Nuclear Emergency Management and Response Plan.

In principle, the approach adopted in the Netherlands enables regulation in accordance with current international practice, and to be flexible in adopting further requirements if this changes. The Dutch legal framework gives the RB adequate powers to require any Severe Accident Management (SAM) measures it deems necessary, the main instrument being through the operating licence.

The Decrees include specific requirements for numerical risk. These are general requirements that apply to all industrial activities in the Netherlands. From this, risks need to be less than: 10^{-6} per year for individual risk (mortality) as a consequence of operating an installation; 10^{-5} per year for societal risks, i.e. risks directly attributable to events leading to 10 or more fatalities. Supplementary criteria

are also applied, requiring a hundredfold reduction in this limit for each tenfold increase in the predicted number of fatalities.

The LH has conducted complete Level 1, 2 and 3 PSAs, which include external hazard initiators. The full scope Level 3 PSA (which utilises the COSYMA computer program) results in estimated risk levels compliant with the regulatory criteria outlined above. These are “living” PSAs, i.e. they are updated yearly. They also provide input to the surveillance and maintenance strategies, modification planning and execution, and periodic safety assessments.

The full scope Level 3 PSA has been used to derive LH’s (EPZ) SAM strategy.

SAM strategy at the LH

The on-site emergency plan includes a specific emergency organisation with adequate staff, instructions and resources.

The emergency plan has three principal goals:

- to ensure that the operating organisation of the NPP is prepared for any on-site emergency situation;
- to mitigate as much as possible the effects on the operating personnel of the NPP and on the environment in the vicinity of the plant;
- to advise the relevant governmental bodies as effectively as possible on emergency actions that should be taken.

SAMGs

Twin strategies are applied to manage a severe accident. Due to the layout of the reactor pit, the generic in-vessel retention strategy is not feasible in Borssele NPP. The SAMGs conservatively assume that the corium will ultimately penetrate the basemat and the corresponding strategy is to prevent a high-pressure melt-through scenario. Since this is a very conservative assumption, the SAMGs also take into account that a coolable configuration of the corium will be reached due to the spreading of the corium. The associated strategy is to enhance cooling of the corium by supplying water (through the damaged reactor vessel) to the corium. The LH is currently reviewing international research to better underpin these strategies.

Severe Accident Management Guidelines (SAMGs) have been in operation at Borssele NPP since 2000 as an outcome from the PSR at the plant in 1993. Their scope was expanded following the 2003 PSR to include shutdown conditions. The SAMGs are based on the generic SAMGs produced by the Westinghouse Owners Group and were considered state of the art in 2003. They are intended to address scenarios deriving from severe external hazards, such as earthquakes and floods, where there is the imminent potential for core melt.

The SAMGs include guidance for using the pressure relief valves and various pressuriser spray options to control the Reactor Pressure Vessel (RPV) pressure. For an ex-vessel event the containment (37,100m^3) has filtered venting, a spray system, air coolers, a filtered recirculation system and Passive Autocatalytic Re-combiners (PARs). The containment is designed for overpressures of 3.8 bar.

Classification

The incident/accident classification system used by the Borssele plant is in line with the classification system used in the National Nuclear Emergency Management and Response Plan (NPK). This, in turn, corresponds to the IAEA emergency classification system, incorporating: ‘Emergency Stand-by’, ‘Plant Emergency’, ‘Site Emergency’ and ‘Off-Site Emergency’. The various types of emergency procedures, and the emergency plan and the emergency organisation of the operating organisation, are sent to the RB for review and approval.

Communication of the LH with the RB in emergency situations

If an emergency occurs, the plant management must inform the relevant authorities immediately, advise them of the classification of the accident, and provide whatever information is required in order to assist the KFD to assess the nature and potential consequences of the accident, to determine the potential for mitigating its effects and to make a prognosis of potential radioactive discharges. Real-time data and process information is available to the inspection branche of the RB, the KFD. This is part of the plant information supplied to the KFD during an emergency. The RB has a strict 24/7 schedule to secure its availability during any actual or potential accident or serious incident.

SAM facilities at the LH

Borssele has standard arrangements for controlling the plant in the event of a severe accident. The Main Control Room (MCR) has a filtered air supply and, following a Station Black Out (SBO) event, compressed air and respirators are available. There is also an alternative Emergency Control Room (ECR, which is bunkered and has gas-tight doors, but which does not have a filtered air supply) for managing a controlled shutdown, core cooling and spent fuel pool cooling. Both the MCR and ECR have suitable and robust access to plant measurements needed to control a severe accident.

There are seven operations shift teams at Borssele, each managed by a shift supervisor and each composed of at least eight operators. It is the shift supervisor's responsibility to decide on the extent of the LH's Emergency Response Organisation (ERO) that needs to be activated. Once the ERO is operational, the site emergency director takes over responsibility for the emergency. Based on data from exercises, the ERO will be set up within 45 minutes (also outside normal working hours) and then requires a further 30 minutes to become operational.

The ERO is a scalable organisation: the number of staff called in (by pagers, phone calls) will depend upon the scale of the emergency being addressed. The ERO will be located in the plant's Alarm Coordination Centre (ACC). This is a purpose-built facility designed for internal events and emergencies. Though bunkered (like the ECR), it is not designed to withstand severe events such as a major earthquake, flood or aircraft crash. If damaged, ERO has to use an other room, but consequently lose some of the dedicated ERO-facilities.

Details of the SAM facilities at the LH can be found amongst others in the National Report of the Netherlands on the evaluation of the complementary safety assessment of the Borssele NPP, published in 2011.

Training of the emergency organisation of the LH

The training requirements are described in the various procedures and in the manual on emergency drills. The plant management is required to provide a schedule of regular emergency drills and classroom training. A part of the obligatory training plan for shift staff is devoted explicitly to teaching them how to deal with emergencies.

Training and emergency exercises are conducted routinely and include change-over of ERO shifts. Scenarios are controlled using the plant's full scope simulator (located in Essen, Germany), though it is noted that this cannot simulate severe accidents. Emergency exercises can be very large scale, e.g. a national exercise in 2011 involved 1000 people. The LH produces an annual summary report of its exercises which is assessed by the regulator. The inspectorate branche of the RB (the KFD) participates in six emergency exercises annually. One or two KFD-inspectors are based at the ERO location to observe the exercise and to check if the correct measures are taken to restore safety functions.

The larger exercises incorporate the participation of the various government organisations at local, regional and national levels, like the National Crisis Centre, NCC. The last full-scale exercises were in

May 2005 and September 2011. The next one is not scheduled yet. In general the periodicity for such national full scale exercises is every 4 to 5 years.

The LH has learned from recent exercises that it is necessary to have a sound communication plan for emergency situations. This plan is being written. Communication with external entities is found to be complicated and therefore always is a focus point of the excercises. In the current arrangements, LH EPZ has a liaison who is sent from the plant to the local authorities to explain the emergency situation. This arrangement is found to be very useful. Therefore it has been decided to train the liaison in all excercices the authorities participate in. The LH also learned that the number of the emergency staff on some functions had to be doubled because of the workload they may have during an emergency. It was also experienced that the preparations of large excercises with external parties, must start early. Especially the determination of the objectives of the exercise, needs thorough consideration.

Evaluation of SAM capability and (potential) safety improvements

In the European ENSREG-led Complementary safety Assessment or 'stress test', the LH has evaluated his SAM capability and has judged it adequate, although noting several options for improving on this capability. The RB has reviewed the findings which resulted in refinement of the list of actions. A list of numbered actions and topics for further research can be found in the table in the Summary of the present report. Examples of notable improvements are discussed below.

When EPZ's Emergency Response Organisation needs to be activated, it will be located in the plant's Alarm Coordination Centre (ACC). This is a purpose-built facility designed for internal events and emergencies. Though bunkered (like the ECR), it originally was not designed to withstand severe events such as a major earthquake, flood or aircraft crash. The LH has therefore proposed a new Emergency Response Centre (ERC) to provide a more robust shelter. In the meantime, the ERO will need to relocate, if the ACC becomes uninhabitable, to a standard meeting room. This will however entail losing much of the functionality (e.g. communications provisions) of the ACC. Interim measures are therefore envisaged to enhance the capability of some of the meeting rooms on site (though not to the same standards as the ERC will have), pending full ERC commissioning.

The LH is currently in the process of developing further a set of Extensive Damage Mitigation Guidelines (EDMGs). They address gross infrastructure problems deriving from a major incident, e.g. blocked roads, or doors no longer amenable for access.

16.1.b Off-site: EP&R and PAM

Off site emergency preparedness and response (EP&R) and post accident management (PAM) mainly is a national responsibility. Nevertheless utility's responsibility is also important especially regarding providing technical information on plant conditions and the potential risk for emissions.

The present section gives a general introduction to the EP&R and PAM in the Netherlands. The developments and actions regarding EP&R and PAM have been discussed.

Regulatory framework

Chapter VI of the Dutch Nuclear Energy Act among others describes the responsibilities and tasks of the authorities that are responsible for nuclear emergency management (preparation and response).

Under Article 40 of the Act, the national government is responsible for the preparatory work and for actually dealing with any emergency that may occur in case of nuclear accidents. The operational structure of nuclear emergency preparation and response is based on Article 41 of the Act and is detailed in the National Plan for Nuclear Emergency Management and Response: NPK and the NPK Response Plan. This plan details the measures and mandates that are available to the national authorities during a nuclear accident.

Responsibilities of ministers

The minister of Economic Affairs coordinates efforts on management of nuclear accidents. This minister is also responsible for the radiation protection measures (for protecting the population). The other ministers have responsibilities that are linked to areas that are specific for their own ministries. Examples are:

- Minister of Security and Justice: for national decisions in crisis situations, maintain order and guaranteeing security;
- Minister of Health, Welfare and Sport for medical aspects and public health;
- Minister of Social Affairs and Employment: for safety at work;
- Minister of Defence: for accidents with military nuclear materials;
- Minister of Economic Affairs: also for agricultural aspects and safety of food stuffs;
- Minister of Infrastructure and the Environment for the environment, drinking water, transport infrastructure and water management.

All ministers are responsible to maintain an adequately educated and trained emergency management unit and a coordination centre for the areas that are in their domain. The National Crisis Centre (NCC) is the responsibility of the minister of Security and Justice.

National Organisations for EP&R and PAM

The operational structure of nuclear emergency preparation and response is embedded in the National Nuclear Emergency Plan (NPK). For advice on managing an emergency, there is a dedicated information unit, the 'EPAn'[44], the national nuclear assessment team. This team advises whenever there is a real threat of an off-site emergency in a nuclear installation or a radioactive release (in the Netherlands or in a neighbouring country). The EPAn has the following components:

- One Front Office (FO) coordinating the advice on the national level to various entities like the Regional Policy Team ('RBT[45]', acting at the regional level near the NPP), the Commissionn Coordination Emergency Management ('ICCb') and the ministerial Commission Crisis Management ('MCCb') coordinating activities on the national level.
- Two Back offices, providing the Front Office with situation reports, analyses and prognoses regaring the accident at hand, also indicating if and where intervention level will be exceeded, requiring mitigating radioprotection measures and medical interventions:
  1. Back Office Radiological Information (BORI),
  2. Back Office Medical Information (BOGI)

The Back Offices consists of staff from organisations like the inspectorate branche of the RB (the KFD), the Royal Meteorological Institute ('KNMI'), the National Institute for Public Health and the Environment (RIVM[46]) and RIKILT, a department of the University in Wageningen. RIKILT will monitor compliance with legal food standards and will advice and assist during food-related emergencies. RIVM can provide for radiological information on projected dose data on the basis of dispersion calculations and monitoring data concerning the environment, drinking water and foodstuffs. RIVM operates the national radiological monitoring network (NMR[47]) and in addition monitoring vans. It also collects data from other institutes. The inspectorate branch of the RB (KFD) has an important role in assessing the status of the relevant nuclear installation, the accident prognoses and the potential source term. In addition, KFD inspectors go to the accident site to closely monitor the event and support the oversight process.

[44] Dutch: 'Eenheid Planning en Advies nucleair', EPAn
[45] Dutch: RBT, 'Regionaal Beleidsteam'
[46] Dutch: 'Rijksinstituut voor volksgezondheid en milieu', RIVM
[47] Nationaal Meetnet Radioactiviteit, NMR

Local organisations for EP&R and PAM

Under Article 41 of the Act, the local authorities also have a responsibility in making regional/local contingency plans for emergencies. Fire fighting service, police and health services can be involved. The mayor has responsibilities to maintain public order and safety. The mayors of municipalities liable to be affected by accidents involving nuclear power plants located either within their boundaries or in their vicinity (including those across national borders) have established emergency contingency plans in consultation with representatives of central government. These plans are obligatory under Article 3 and others of the Disasters and Major Accidents Act[48], and encompass all measures that need to be taken at both local and regional levels. In more severe accidents with regional consequences, a Regional Operational Team and a Regional Policy Team is established. The Dutch Safety Region Act gives responsibilities for the regional authorities to mitigate the effects of the accident as much as possible. The national Nuclear Assessment Team (EPAn) will provide advices for policy teams on national as well as policy teams on local or regional level to execute urgent countermeasures to protect the population and the workers in the area. Exercises are held at regular intervals.

Intervention levels and measures

The measures that are to be taken at the various intervention levels have been listed in Table 3.

The intervention measures and levels have been established by the RB following discussions with national experts in the relevant fields. International expertise and guidelines were also taken into account. There was no direct involvement of other stakeholders because the protection of the public in case of possible emergencies is a primary responsibility of national government. There are also derived intervention levels for foodstuffs, based on the appropriate EU regulations.

The intervention level for the protection of the public varies widely from one country to the next. While awaiting harmonisation directives from the European Commission in this respect, arrangements have been made with neighbouring countries to introduce matching measures in border areas, regardless of any differences in national intervention levels.

Iodine tablets have been (pre)distributed to the citizens/households in the emergency planning zones of the NPP Borssele. In the process of predistribution, a special communication campaign was executed. In this region, Iodine tablets are also available at pharmacies and at town halls.

[48] Wet rampen en zware ongevallen, Wrzo

Table 3 Measures and intervention levels

Measure	Intervention level
Preventive evacuation:	1000 mSv H_{eff} (24 hours dose)
First day evacuation:	200 mSv H_{eff} (48 hours)
Late evacuation:	50-250 mSv (first year dose)
Relocation/return:	50-250 mSv (first 50 years after return)
Iodine prophylaxis:	100 mSv (child, 48 h); 1000 mSv (adult, 48 h)
Sheltering:	10 mSv H_{eff} (48 h)
Cattle grazing prohibition:	5000 Bq I-131 per m^2
Milk (products), drinking water etc:	500 Bq/l I, 1000 Bq/l Cs, 125 Bq/l Sr, 20 Bq/l alpha emitters.

Dimensions of emergency planning zones for Borssele
The planning zone covers all municipalities that are involved in the preparation, based on the reference accident-scenario for the nuclear installation. This zone has a radius of 10 km from the Borssele NPP. The mayor of Borssele coordinates the preparatory aspects of the emergency plan and the execution of measures during an accident.

The various zones for countermeasures are defined geographically:
- Evacuation zone: circle with a radius of 5 km
- Iodine prophylaxis: circle with a radius of 10 km
- Sheltering zone: circle with a radius of 20 km.

It should be noted, however, that measures are coordinated at the national level in case of nuclear emergencies. Decisions will be made based on the technical information available during the emergency. The proper emergency zoning will be established, where countermeasures will be taken. In most cases this will be in the planning zone, but when needed it can be outside of this zone.

New emergency planning zones
The policy regarding planning zones is being evaluated, taking notice of the emergency planning policies in neighbouring countries.

Criteria for emergency situations
Following consultation with the Ministry of the Environment and particularly with the KFD, Borssele NPP has adopted the four classification levels in the IAEA system for use in its Emergency Plan. Each level is associated with incident/accident parameters ranging from a small fire to a large actual off-site release. Difficult elements to capture in the criteria are potential/probable consequences which have not yet occurred but which nevertheless call for larger-scale protection and prevention measures.

The specific parameters are:
1. Emergency stand-by: Emission < 10 * permitted daily emissions (noble gases; this means for the Borssele NPP $1.3*10^{15}$ Bq Xe-133 equivalent). No intervention levels are reached.

2. Plant emergency: Emission ≥ 10 * permitted daily emissions (noble gases). No intervention levels are reached.
3. Site emergency: Emission ≥ 0.1 * accident emission (the accident emission for the Borssele NPP is defined as ≥ 3 * 10^{17} Bq Xe-133 and ≥ 5 * 10^{13} Bq I-131), or an emission which leads to the lowest intervention level for indirect measures. This lowest level is a soil concentration of 5000 Bq I-131 per m^2; at this level a grazing prohibition must be considered. Furthermore, as the 0.1 * accident emission may lead to a dose level of 0.5 mSv H_{eff} or 5 mSv H_{th} in the first 24 hours after commencement of the emission, off-site measures may be considered in the form of population sheltering.
4. Off-site emergency: Emission ≥ accident emission, being the emission that leads to the lowest intervention levels for direct measures. These lowest dose level is 10 mSv H_{eff} in the first 48 hours after commencement of the emission. At this level, population sheltering must be considered.

The emission level at which the ‘Emergency stand-by’ category changes to the ‘Plant emergency’ category (the transition point) follows directly from the permitted emission as laid down in the licence. The two other transition points depend, among other things, on the accident emission chosen. Determination of the accident emission is based on an emission of noble gases from the chimney. The reason for not using other nuclides as the trigger is that the classification on the basis of plant status will take place before a certain emission level of the nuclides has been reached; this does not apply to noble gases. In addition, a noble gas emission can be measured directly, and is therefore more suitable as a first trigger than say, an I-131 emission, which can only be measured with any degree of accuracy after a period of around an hour. The Xe-133 equivalent has been adopted as the yardstick for noble gas emission.

NPK response plan, training exercises and their organisation

Based on the lessons learnt from the National Full Scale Nuclear Exercise of 2005, the arrangements for nuclear emergency management and response (i.e. the ‘NPK response plan’) were published in 2009 and last updated in 2011. The plan describes the structure and responsibilities of the various organizations involved in nuclear emergency management. It also describes the scenarios of potential nuclear and radiological accidents. The key organization managing nuclear accidents is the National Nuclear Assessment Team (EPAn). The NPK Response plan is available in Dutch only.

Based on the NPK, the Dutch training and exercise programme for nuclear emergency management and response features a four-years training- and exercise-cycle that is implemented in the annual programmes. Training is organized for different topics e.g. the use of Emergency Information and Decision Support Systems, and some exercises. A full scale exercise is planned approximately every five years. In these national exercises the interaction between generic national emergency management structures and nuclear emergency management and response are integrated.

Officials of different departments and organisations of the National Nuclear Assessment Team (EPAn) participate in exercises and trainings. They all have their own expertises and roles during such an exercise and during an actual accident-response. Examples of such roles are performing radiological/technical analyses, advising on health aspect, etc.

Nuclear and radiological training and exercises are organised by the Ministry of Infrastructure and the Environment (IenM/ILT), under the responsibility of the minister of Economic Affairs (EZ). The Ministry of Safety and Justice is responsible for the generic national responseorganisation and for exercises to train this organisation. Ministries work together in the organisation of integrated large scale exercises.

16.2 Providing information to the public and neighbouring states

16.2.a Arrangements to inform the public about emergency planning and emergency situations

Chapter VI of the Nuclear Energy Act also addresses (in Article 43) the provision of information to those members of the population who might be affected by a nuclear accident. Consistent with its responsibility for managing the response to a (potential) nuclear accident, national government also is responsible for informing the public. This will be done in close cooperation with the local authorities in the threatened or affected area.

In case of a threat or emergency that needs national coordination, and needs the involvement of various ministries, the NCC will set up a national crisis communication centre to inform the public. Experts from the various ministries will help and support the local and regional Public Information Units based on the recently developed Communication Strategy for Nuclear and Radiological Emergencies. Public information about the potential risks of nuclear power plants and the existing emergency plans is provided by the municipalities (EU directive). The material needed for the information may be provided by central government, as has been the case for the municipalities in the vicinity of the Borssele and Doel NPPs, the latter being in Belgium but close to the Dutch border.

In addition, the governmental websites have a link to the topic of ‘crises’, where information can be found on numerous aspects of nuclear accidents. Another part of the site, to be open to the public only in emergency situations, contains a more comprehensive set of relevant questions and answers.

16.2.b Arrangement for informing competent authorities in neighbouring countries

The provision of information to the authorities in neighbouring countries is the subject of Memoranda of Understanding (MoU) that have been signed with bordering countries. The exchange of technical data (such as monitoring results and modelling-assessments) takes place on a regular basis and in a response-phase between the Netherlands and Germany. With Belgium, the same approach is in preparation. Information exchange at the international level is regulated by the Early Notification Convention of the International Atomic Energy Agency and the European Commission’s ECURIE directive on urgent information exchange. On bilateral bases, information about (potential) nuclear or radiological emergencies will be exchanged between the respective national crises-coordination centres also.

In the Regional Nuclear Emergency Plans for nuclear facilities such as the Borssele NPP and the NPP Doel (Belgium) in close bilateral cooperation, arrangements for better and efficient information-exchange and compatibility of countermeasures are being set up. To learn more about national nuclear emergency plans and the approaches for decision making, arrangements are made to exchange observers from bordering countries in case of relevant exercises with NPPs in border areas.

CHAPTER 2(D) SAFETY OF INSTALLATIONS

ARTICLE 17. SITING

17. Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented:

i. **for evaluating all relevant site related factors likely to affect the safety of a nuclear installation for its projected lifetime;**
ii. **for evaluating the likely safety impact of a proposed nuclear installation on individuals, society and the environment;**
iii. **for re-evaluating as necessary all relevant factors referred to in subparagraphs (i) and (ii) so as to ensure the continued safety acceptability of the nuclear installation;**
iv. **for consulting Contracting Parties in the vicinity of a proposed nuclear installation, insofar as they are likely to be affected by that installation and, upon request providing the necessary information to such Contracting Parties, in order to enable them to evaluate and make their own assessment of the likely safety impact on their own territory of the nuclear installation.**

17.(i) Evaluation of site-related factors

The Acts applicable to licensing of a nuclear installation have been listed in the text on Article 7. Main examples are the Nuclear Energy Act (Kew), the Environmental Protection Act (Wm) and the General Administrative Act (Awb). Also several Decrees and Ordinances apply; they too can be found in the text on Article 7.

There are also several Nuclear Safety Rules (based on IAEA guides) that apply to the site evaluation. These are referenced in the licence of the installation.

At the time of the construction of the Borssele NPP, other rules applied to the site evaluation than today. However in the various licence applications for modifications, updates of the Safety Analyses Report and Safety Report and the associated various PSRs, attention has been given to site specific threats to the facility.

The safety case of Borssele evaluates the human induced threats. These may generally result from an accident in the industrial environment, from pipelines or from an accident on a nearby road or railway or the river. The resulting risks for these events have been evaluated in the PSA for external events and were found to be very low. The dyke offers protection, and the calculated pressure waves will not harm the installation. To counter delayed ignition of a vapour cloud, an automatic detection and ignition system has been installed on the seaward side of the dyke.

Supervision

In the current situation there is no separate site licence or a site permit. This means that the inspection branch of the Regulatory Body (RB) does not have a formal oversight possibility until a construction licence is given. Currently there is the possibility that the new PALLAS research and medical isotope production reactor will be built. This will be the first new-build reactor project after more than 40 years. The RB therefore may have to reevaluate the legal framework in order to make pre-licensing

inspection activities possible. In the meantime, regardless the absence of a formal role in siting, the RB could define activities in the pre-licensing phase that would support the oversight process when a licence is issued.

Currently (2013) the RB is starting the development of an inspection strategy for new build nuclear installations. Part of the development of this strategy is discussion about possible activities in the pre-licensing phase (including siting aspects).

17.(ii) Impact of installation on individuals, society and environment

Before a licence is granted, the applicant has to specify all 'relevant site-related factors that may affect the safety of the plant'. Examples of site-related factors are events induced by human activities, such as aircraft crashes or gas cloud explosions, and events due to natural causes such as seismic phenomena and high tides.

In September 2009 the third Electricity Supply Structural Plan (SEV III [49]), became operational. SEV-III reserves space for large-scale production and transport of electricity. In SEV-III, on the basis of a preliminary selection procedure, three locations have been selected and in principle warranted for the siting of a nuclear power plant. However, the site selection process during the licensing procedure should further assess the consequences and the suitability of the site. There are no specific locations selected for other nuclear installations (not being NPPs).

The main site-relevant factors that have been taken into account in the preliminary selection are:

- Any special circumstances which prohibit the building of a nuclear power plant on a particular site, e.g. the presence of an airport or of industries with the potential for the release of explosive or toxic substances in the vicinity, or certain difficulties involving the existing electrical power grid;
- The population density within a radius of 20 km around the site, and especially in the most densely populated 45° sector around it. If these weighted population densities are too high compared with the weighted population densities for a reference site, the proposed site will be removed from the initial list.

17.(iii) Re-evaluating of relevant factors

The Licence Holder (LH) is required to perform regular safety assessments, the Periodic Safety Reviews (PSRs). The licence describes the nature of these assessments and also specifies the maximum period between them. For example, the safety of the nuclear power plant as a whole must be re-evaluated every 10 years in the light of new safety insights and generally accepted safety practices. Account must be taken of 'site-relevant factors' as mentioned in the section on Article 17.(ii). Also refer to the section on Article 14 for the PSRs.

In addition, recently (2011) there has been the European Complementary Safety Assessment (CSA) or 'stress test'. In this assessement, site related aspects have been given extra consideration. Threats like flooding and earthquakes with magnitudes of very low probability have been considered in this safety margin assessment. Also combinations of natural hazards were considered; but this was already the case in the conventional PSRs. Associated with this, the consequences of (and mitigation of) loss of infrastructure and site access have been evaluated.

The recent re-evaluation in the 'stress test' has established that the NPP has safety margins past its licence base, but that options exist to increase these margins even further.

[49] Structuurschema Elektriciteitsvoorziening III

17.(iv) Consultation with other contracting parties

The procedure for obtaining a construction licence for a nuclear installation includes an obligation to submit an Environmental Impact Assessment (EIA). As part of this procedure, neighbouring countries that could be affected by the installation are notified on the basis of the Espoo Treaty and an EU Directive:

- The Espoo Treaty of 26 February 1991. The Netherlands ratified this treaty on 28 February 1995 and the European Union ratified it on 24 June 1997; the treaty came into force in September 1997.
- Council Directive 97/11/EC of 3 March 1997, amending Directive 85/337/EEC on the assessment of the effects of certain public-sector and private-sector projects on the environment. The Espoo Treaty has been subsumed under this Council Directive.

The Netherlands has incorporated the provisions of the Espoo Treaty and the EU Directive into its Environmental Protection Act. Chapter 7 of this Act deals with environmental impact assessments and the relevant procedures. These include the provision of information to neighbouring countries and the participation of the authorities and the general public.

A special bilateral committee for nuclear installations (NDKK[50]) has been set up with Germany to promote an effective exchange of information between the two countries. Originally the prime function of the NDKK (established in 1977) was to improve and guide participation by citizens (living in the proximity of the border) in the licensing procedures of the neighbouring state. Later, it assumed the additional function of a platform for the exchange of information on more general nuclear topics such as the technical aspects of installations near the border, developments in regulations and emergency preparedness activities.

A bilateral Memorandum of Understanding (MoU) of a similar nature has been agreed with Belgium.

The government is also bound by the provisions of Article 37 of the Euratom Treaty, under which all relevant data on the safety and environmental impacts of any nuclear installation that could affect a neighbouring EU Member State must be submitted to the Article 37 Expert Group before a licence can be issued by the Regulatory Body. This Expert Group advises the European Commission on the acceptability of the proposed installation on the basis of safety evaluations. The Commission thereafter informs the Member States concerned of the outcome of these evaluations.

[50] The NDKK is the Dutch-German committee for nuclear installations in the border regions.

ARTICLE 18. DESIGN AND CONSTRUCTION

18. Each Contracting Party shall take the appropriate steps to ensure that:

- **i. the design and construction of a nuclear installation provides for several reliable levels and methods of protection (defence-in-depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur;**
- **ii. the technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis;**
- **iii. the design of a nuclear installation allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface.**

18.(i) Defence in depth

A design must be based on the defence-in-depth concept as defined in NVR-NS-R-1 'Safety Requirements for Nuclear Power Plant Design' in order to achieve the general safety objectives laid down in the various design related NVRs. 'Defence-in-depth' is the name given to a safety philosophy consisting of a set of diverse and overlapping strategies or measures, known as 'levels of defence'. The 'Defence-in-depth' principle is described and implemented in various nuclear safety standards and documents. An important one is the INSAG-10 report 'Defence in Depth in Nuclear Safety' which identifies five levels of defence. An important principle is that the means provided on one level of defence should be independent from those of other levels. This ensures that the failure of one system will not affect more than one level of defence.

Currently the Borssele NPP meets the requirements regarding the defence-in-depth concept. Its compliance is summarized below:

- The first level of defence shall prevent abnormal operation and failures. Operational experience, especially as indicated by collected plant-specific component failure data, data resulting from the non-destructive testing of the primary pressure boundary, as well as the programmes for inspection, maintenance, testing, ageing etc. applied to plant systems and components, has shown that the first level of defence is adequately preserved.
- The second level of defence shall control abnormal operation and timely detect failures. In the Operational Limits and Conditions (OLC) document the limits are defined within which the Borssele NPP must operate. In order to ensure that the limits are not exceeded, the safety systems are subject to an extensive set of in service inspection, surveillance and maintenance procedures. These procedures together with the Operational Limits and Conditions document form the second level of defence.
- The third level of defence shall control accidents within the design basis. The essential means provided consist of the safety systems and other measures to control Postulated Initiating Events (PIEs) including Limiting Design Basis Events. The safety analyses that are reported in the Safety Report have to prove that the radiological consequences of design-basis events meet the radiological criteria. These radiological criteria specify smaller acceptance doses if the assumed frequency of the PIEs increases. These criteria are specified in Appendix 1.
- The fourth level of defence shall control severe plant conditions. This is realised by the symptom-based Emergency Operating Procedures (EOPs) and the Severe Accident Management Guidelines

(SAMGs), that need to prevent or mitigate consequences of severe accidents should they happen despite the presence of levels 1-3.

- The fifth level of defence shall mitigate the radiological consequences of significant releases of radioactive materials in the unlikely event that they would occur. It is covered by the strategies for off-site emergency preparedness. See the section on Article 16 for more information on these strategies.

In 2010 the Borssele NPP finalised most of the last modifications derived from its second 10-yearly periodic safety review that was undertaken in 2003. See Appendix 5 for details.

Currently the 3rd PSR is ongoing and will be finished in 2013, with implementation of the improvements in 2014-2017. Also in 2011 the European Stresstest as a response to the Fukushima Daiichi accident has been carried out. The improvements from this safety review will be implemented in the same time frame. The third PSR will amongst others verify how the NPP can comply with the new design requirements and guides introduced in 2011. Also the design of the plant is compared with the safety objectives of new reactors, published by the WENRA in 2010. Results will be presented at the CNS 2014.The improvements made from the 'stress test' are listed in the summary and more information on a selection of them is presented in the text on Article14. One of the requirements issued by Regulatory Body (RB) has a relation with defence in depth: the License Holder (LH) has to evaluate and improve the survivability of equipment (SSCs) that may be of high value during severe accidents (thus at the level 4). This is sometimes called the "hardened core".

Structures,Systems and Components
The identification and classification of the function and significance of structures, components and systems on safety is based on NVR 2.1.1. This Safety guide is an amended version of SS 50-SG-D1 defining four safety classes. Classes 1 to 3 are equivalent to the first three safety classes of SS 50-SG-D1. Class 4 is an extension for:

- Components whose malfunction or failure could put a demand on a safety system in case of an anticipated operational occurrence;
- Components whose malfunction or failure could lead to a significant release of radioactive materials and/or could cause a significant exposure of the site personnel or the public and for which no safety system might be provided;
- Components that may perform significant functions with respect to the prevention, termination or mitigation of anticipated operational occurrences and/or accident conditions, including severe accidents. A function is considered to be 'significant' if it ultimately improves the safety level of the plant.

For system and component design, acceptance criteria are being used based on standard engineering practices. The responsible contractor is left free to choose which specific code to use – within the restrictions of respective safety guides. The RB assesses the selected code and may formulate additional acceptance criteria. By allowing the contractor to work with a familiar code the occurrence of inadvertent errors may be reduced.

The original design and construction Safety-relevant fluid-retaining components of Borssele NPP (safety classes 1, 2 and 3, as defined by NVR 2.1.1) were designed and constructed in accordance with the earlier ASME Code, Section III, Division 1 'Code for the Operation and Maintenance of Nuclear Power Plants', the Dutch Design Code for pressure-retaining equipment, and various Siemens/KWU component specifications. In the 1990s the KTA safety code was introduced at Borssele NPP including significant additional operational experience.

Conventional electrical installations must comply with standards NEN 1010 and NEN 3410 and electrical equipment, where applicable, to NEN 3125 and NEN-EN 50.014 up to 50.020. The design codes and standards used for nuclear electrical installations are the IEEE standards and the KTA code. For digital equipment the standards are used that are provided by the International Electro technical Commission (IEC), the European Committee for Electro technical Standardisation (CENELEC) and the Verband der Elektrotechnik, Elektronik und Informationstechnik e.V. (VDE). The periodic safety review (PSR) finalised in 1993 found the original design basis to be conservative, based on recent versions of the respective industry codes.

To prevent propagation of a failure from a system classified in a lower safety class into a system classified in a higher safety class, NVR-NS-R-1 prescribes that appropriate independence must be maintained between systems or components of different safety classes. This independence can be achieved by using functional isolation and physical separation.

The Borssele NPP is a two-loop system that was built in the 1970s. Therefore, in the original design physical separation was limited. In the first 10-yearly Periodic Safety Review (PSR), a significant effort was put into creating a physical separation between redundant systems of the two loops. This separation was further improved in the second 10-yearly PSR. In the 3rd PSR this will be reevaluated.

In preparation for the new build plans announced by NRG (research reactor PALLAS) and two other companies (the plans of which were shelved in 2012) a new set of design requirements for new reactors is in a final phase of development. Part of the discussion is the decision to apply them also to existing reactors. For further information see the text on Article 7.

18.(ii) Technology incorporated proven by experience of qualified by testing or analysis

Safety Analysis

The Safety Report (SR) of the Borssele NPP is a two-volume document of little less than 700 pages. In this report a condensed representation is given of all safety related aspects regarding the installation and its surroundings. In addition to the Safety Report, the twenty-volume Safety Analysis Report (SAR), also known as the ‘Technical Information Package’ (TIP), provides extensive background information on all safety related aspects regarding the installation, plant layout en the safety analyses. The SAR also includes all details of the design base accident (DBA) analyses. The licence of Borssele NPP requires keeping the SAR/TIP up-to-date at all times.

The SAR is the starting point for all modifications and maintenance activities and is updated with each modification.

In parallel to the 3rd PSR a new SR and SAR are being developed. The SAR (TIP) will be based on the recent set IAEA safety guides.

NVR-NS-R1 (Safety Requirements for Nuclear Power Plant Design) and NVR-SSG-2 (Deterministic Safety Analysis) state that a full range of events must be postulated in order to ensure that all credible events with potential for serious consequences and significant probability have been anticipated and can be accommodated by the design base of the plant. Appendix 1 specifies the acceptance criteria for the analysis. Refer to the section on Article 14 for regulatory requirements governing the issuance of SARs (and SRs) or their updates.

For the safety analysis of the Borssele NPP, the design basis accidents (DBAs) have been grouped in the following ten categories:

1) Increased heat removal by the secondary cooling system
2) Decreased heat removal by the secondary cooling system
3) Decrease in flow in the primary cooling system
4) Pressure changes in the primary system

5) Inadvertent changes in reactivity and power distribution
6) Increase of cooling inventory in the primary system
7) Leakage of cooling inventory from the primary system
8) Radioactive releases from subsystems and components
9) External events (containing among others earthquakes, plane crashes, flooding and external fires)
10) Miscellaneous (containing among others fire and explosions inside the power plant, internal flooding of safety relevant buildings and leaks in reservoirs with highly energetic contents inside the reactor building)

From the 90 postulated initiating events, a selection has been made of a group of representative enveloping events that cover the consequences of all these events.

Where it is credible that combinations of randomly occurring individual events could lead to anticipated operational occurrences or accident conditions, they are considered as a basis for the design. In the case where events occur as the consequence of other events, these events are considered as a part of the original postulated event.

In the analysis of design basis accidents, the single failure criterion has to be taken into account. The single failure criterion is satisfied when an assembly or equipment is able to meet its purpose despite a single random failure occurring anywhere in the assembly. For the design base accident analysis it is assumed that exactly the one safety-related component fails that has the greatest effect of aggravating the consequences of that accident.

NVR-NS-R1 prescribes the limitation of the impact of common cause failures by the application of diversity. The design of the Borssele NPP incorporates diversity in several ways, such as diversity in process parameters(e.g. high pressure or high temperature) to initiate safety system actions, diversity in equipment's driving force (e.g. steam driven and motor driven emergency feed water pumps), and diversity in manufacturing (e.g. different manufacturers for 'normal' and 'bunkered' emergency feed water pumps). In the two 10-yearly PSRs this diversity has been enhanced.

Severe accident vulnerability of the installation
During the first 10-yearly Periodic Safety Review (PSR), the Borssele NPP made a thorough study on the capabilities of the installation with respect to severe accidents. Based on this study both hardware and procedural measures were taken to expand its capabilities to prevent and mitigate the consequences of a severe accident. The hardware measures involved amongst others the installation of passive hydrogen recombinators, filtered pressure relieve of the containment and filtered air supply to the control room and a separate emergency control room. The procedural measures consisted of the introduction of an extensive set of symptom-based Emergency Operating Procedures (EOPs, for prevention) and Severe Accident Management Guidelines (SAMGs for mitigation). The EOPs are based on the Westinghouse Owners Group guidelines and consist of guidelines for the Emergency Support Centre, which initiates required actions, and procedures for the control room staff.

With the implementation of the measures of the second 10-yearly PSR further measures have been taken like for example improved extinguishing agents and capability to fight large kerosene fires, the implementation of automatic pressure relieve hatches to improve natural circulation inside the containment in order to prevent too high local hydrogen concentrations and the introduction of SAMGs for non-power conditions.

Qualification of systems and components
The safety-relevant fluid retaining components of the Borssele NPP were constructed in accordance with German material specifications. For example the steam generator tubing is made of Incaloy 800 and the control rod drive penetrations are of ferritic steel rather than Inconel 600. The PSR confirmed the low nil-ductility transition temperature of the reactor pressure vessel. New mechanical components installed during the Modifications Project (1997), were made in accordance with the KTA design and

construction rules, Siemens/KWU Konvoi component specifications (updated in 1992) and other international standards for nuclear products. Advanced (and proven) technology was introduced with the Super Compact Tandem Safety Valves on the primary system, which were qualified by analysis, laboratory tests and test loop experiments.

Dutch design and construction codes for pressure vessels do not contain a nuclear section. For all construction and modification activities, the LH proposes which nuclear design and construction code to use. The Dutch RB assesses the norms, standards and constructions of this code and depending on the result additional requirements are formulated. In order to ensure that the design codes used are applicable, adequate, sufficient and up-to-date only design codes have been approved that are internationally accepted, like ASME III, KTA and RCC-M.

The technology for the design and construction of safety systems and components for the Borssele NPP has been qualified by analysis, testing and experience in accordance with the requirements of the relevant safety regulations.

Two examples of this process are the introduction of new fuel elements and the large-scale replacement of electrical components.

Starting with the refuelling outage of 2005 new fuel elements with the improved corrosion and hydrating resisting Zirconium-Niobium cladding material M5 have been deployed. Other features of these new HTP fuel elements are the presence of a debris filter in the bottom of the fuel assembly, and new spacers to avoid grid-to-rod fretting. The M5 material had already been tested in other reactors and in laboratory experiments. The relatively high burnups of 67 MWd/tU prompted the RB to require the LH to follow the results from measurements in other plants and research facilities and report this on a yearly basis. Also for the introduction of MOX-fuel the same approach was chosen. In 2014 a first reload is forseen with 4 lead assemblies.

In the 1980s, Borssele undertook a programme of partial replacement of electrical components, including instrumentation and control, in order to improve the environmental qualifications of the equipment involved. Since then, electrical components etc. in safety classes 1, 2 and 3 placed inside the containment have met the IEEE class 1E qualifications. Borssele components that must meet design-basis LOCA environmental conditions now also meet the Konvoi or VGB (Association of German Power Plant Operators) qualifications. Electrical equipment is qualified on the basis of type testing, analysis and experience.

All products and services were delivered by suppliers that are either qualified by VGB or by the architect engineering company (Siemens, Framatome) under an extensive quality control programme verified by independent inspectors. Quality assurance programmes were introduced in the 1980s and resulted in the partial transfer of quality control work to suppliers. Currently the NPP has a vendor rating system.

18.(iii) Design in relation to human factors and man-machine interface

The 1997 modification programme undertaken at Borssele included consideration of a whole range of man-machine interface elements (also discussed in the section on Article 12). The most notable elements of the programme included the redesign of the control room, the addition of a backup emergency control room and additional local control capabilities to improve process information and controllability in all plant states, including emergency situations. Other important elements were the redesign of interlocking control processes (i.e. bridging, key-operation, and automatic blocking), tackling communication problems, evaluating and improving the accessibility (in terms of physical access and radiation doses) of systems and components during operational states and in emergency situations, and adding remote controls and indicators for safety-relevant components. As a result of the ‘stress test’ the improvement of accessability and operability of systems and components under severe

circumstances will be a measure. Also more remote operation and reading parameters from a distance or easy connectable mobile equipment are important.

A representative mock-up was used to optimise the design of the control room in terms of human factors. Uninterrupted sightlines, readability, communication, manageability and walking distance optimisation were all studied and the results implemented. Control room staffs were also involved in planning the layout. See Appendix 5 for a more detailed description of man-machine interface aspects at the Borssele NPP.

In addition to the Reactor Protection System (RPS) there is the Engineered Safety Features Actuation System (ESFAS) that is designed such that for all design base accidents no operator action is required during the first 30 minutes after start of the event. An exception is allowed for simple actions with clear criteria after the first 10 minutes. In addition, there is a ‘limitation’ system that initiates corrective actions to prevent activation of the RPS and ESFAS systems. All relevant safety related parameters are shown on a special panel, so that the operator is able to check all important safety parameters at the same time.

The design also ensures that the plant is kept in a controlled safe state during a minimum of 10 hours after an external event, without any operator actions (autarky). One of the stresstest measures is to see if this autharky time can be improved futher. After the most recent PSR, the time that the plant can be kept in a controlled safe state after an event, without the need for off-site assistance or supply (autonomy) has for external events been expanded from 24 hours to 72 hours minimum, which is equal to that for internal events.

A new development in the training of workers is the building of a special building with mochup’s of some parts of the mechanical and electrical installation, where for instance maintenance activities kan be simulated.

ARTICLE 19. OPERATION

19. Each Contracting Party shall take the appropriate steps to ensure that:

- **i. the initial authorisation to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning programme demonstrating that the installation, as constructed, is consistent with design and safety requirements;**
- **ii. operational limits and conditions derived from the safety analysis, tests and operational experience are defined and revised as necessary for identifying safe boundaries for operation;**
- **iii. operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures;**
- **iv. procedures are established for responding to anticipated operational occurrences and to accidents;**
- **v. necessary engineering and technical support in all safety-related fields is available throughout the lifetime of a nuclear installation;**
- **vi. incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the Regulatory Body;**
- **vii. programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organisations and regulatory bodies;**
- **viii. the generation of radioactive waste resulting from the operation of a nuclear installation is kept to the minimum practicable for the process concerned, both in activity and in volume, and any necessary treatment and storage of spent fuel and waste directly related to the operation and on the same site as that of the nuclear installation take into consideration conditioning and disposal.**

19.(i) Initial authorisation to operate: safety analysis and commissioning programme

It should be noted that experience with initial safety analysis and commissioning is limited, as no new nuclear power plants have been built in the Netherlands since 1973. This section is therefore related to comparable experience with:

- Periodic Safety Reviews (PSRs) of the Borssele NPP (see Article 14(i)),
- the results of inspection by international team reviews like OSART and;
- commissioning after significant changes to the installations as a result of a PSR.

As discussed in the section on Article 14(i), an in-depth safety assessment of the NPP has been made. The commissioning aspects concerning modified structures, systems and components are reviewed once the assessments have been completed.

Pursuant to NVR NS-R-2 (Safety of NPPs: Operation), the LH must set up a ‘Commissioning Programme’ (CP). Instructions for this task are provided by NVR NS-G-2.9 (Commissioning for NPPs). The CP has to be approved by the inspectorate of the Regulatory Body (RB), which is the KFD. The KFD has to assess the completeness of the programme but some parts are evaluated in detail. The findings are discussed with the Licence Holder (LH) so that necessary changes can be made, after which the programme can be approved.

The inspectors of the KFD select certain items for closer monitoring during the actual commissioning process. Audits are performed, both by the LH and by the KFD, where necessary assisted by external experts, to ensure that the CP is being properly executed. They focus on the organisation and quality systems of both the LH and its contractors. Nevertheless, the establishment and performance of an appropriate CP remains the full responsibility of the LH.

After refuelling the reactor including all maintenance activities, the LH must submit to KFD the results of all relevant analyses, tests, surveillances and inspections. KFD will evaluate this information to establish whether all SCCs important to safety meet the requirements and certain criteria for reliability, before granting a restart. If no deviations are found the power plant can decide to restart the plant. In the current philosophy of KFD no prior consent will be given, only if there is in issue KFD will formally request not to restart.

The Dutch government in 2006 signed an agreement (Covenant) with the owners of the Borssele NPP, which allows for operation until the end of 2033, if requirements of the operating licence and the Covenant keep being met. More information on the Covenant can be found in Appendix 6. The LH has started a project which should demonstrate that the plant and its organisation are capable of safe operation during its anticipated operating life. This project is based on guidance provided by IAEA Safety Report Series No. 57 ‘Guidance for Safe Long Term Operation’. An important part of the project is the assessment of all safety and design analyses containing design life related assumptions together with ageing management review of all safety and safety related SCCs.

19.(ii) Operational limits and conditions

The Borssele NPP licence states that the conditions must be described with which the systems, system components and organisation of the operation of the installation must comply, as well as the measures taken in order to operate the installation in such a way that all requirements described in the licence are satisfied. These conditions shall be approved in advance by the inspectorate branche of the RB, the KFD.

These conditions are described in the Technical Specifications (TS). The basis for these is NVR NS-G-2.2 (Operational Limits and Conditions and Operating Procedures for NPPs), but NUREG 1431 was used as a basis for their revision. A project team was formed to tailor the standard Westinghouse TS to the Siemens/KWU design. The team included representatives of Siemens (vendor information), Scientech (standard TS information) and the owner of the Borssele NPP, EPZ (plant maintenance and operation procedures). A set of documents was generated showing all changes made to the old TS. Any change to or difference from NUREG was also explained and justified in separate documents. Many new items were introduced into the TS. A separate background document contains the link to the existing safety analysis documents. The TS include the limits and conditions for operation, allowable outage times and surveillance requirements.

All deviations from the TS must be reported to the KFD. The KFD checks on compliance with the TS during its regular inspections.

According to NVR NS-G-2.2 the plant management has the primary responsibility of ensuring that the operational limits and conditions are complied with. To fulfil this responsibility, relevant checks and control systems have been established. All personnel holding responsibility for the implementation of operational limits and conditions are provided with the latest version of the associated documentation. There are written procedures providing for issue and control of operational limits and conditions and their approved modifications. The operating organisation conducts audits to verify compliance with the operational limits and conditions.

The quality assurance system of the Borssele NPP requires the conditions for operation and the limits as laid down in the Technical Specifications to be observed at all times. This has priority over the

economic production of electricity. NVR NS-R-2 (Safety of NPPs: Operation) states that plant management has a direct responsibility for the safe operation of the plant. All safety-relevant management functions must be supported at the most senior level of management. In addition, the organisational structure features a special senior manager who is responsible for the independent supervision of nuclear safety, radiation protection and quality assurance at the plant. He reports directly to the most senior level of management at the Borssele site. This ensures that safety is given a proper role in this efficiency oriented production environment. A project of Borssele concerning risk-informed optimisation of improved allowable outage times has been approved by KFD.

19.(iii) Procedures for operation, maintenance, inspection and testing

The NVR NS-R-2 (Safety of NPPs: Operation) states that operation, maintenance, inspection and testing must take place in accordance with established procedures. Since the NVRs are part of the licence, the LH is bound by these conditions. The plant is operated in accordance with the instructions given in the Operating Manual, which is an extensive document describing all relevant details of plant operation. Specific instructions are given for abnormal conditions, as well as for incidents and accidents (see also the section on Article 19(iv)). These documents are approved by plant management, but are in general not submitted to the RB for approval. However, the Technical Specifications, major changes of the EOPs/SAMGs, the code of conduct and the rules and regulations of the internal and the external reactor safety committee of the plant and the ISI programme have to be approved by the KFD.

The establishment of an Internal Reactor Safety Committee (IRSC) and an External Reactor Safety Committee (ERSC) is a licence condition for Borssele NPP and the HFR research reactor. The IRSC is a reviewing body within the plant management structure to evaluate and review all matters important to nuclear safety and radiological protection. The IRSC advises and reports to the plant management and reports also to the ERSC. The ERSC is a committee under responsibility of the operating organisation to provide independent review and surveillance of the functioning of all internal safety control and safety evaluation provisions within the operating organisation such as quality assurance, IRSC, plant management and structure of the operating organisation. In addition, the ERSC may evaluate and review matters important to nuclear safety and radiological protection. The ERSC advises and reports to the operating organisation. The terms of reference, function, authority and composition of both IRSC and ERSC are subject to approval by the KFD. The Borssele LH has described the utility management processes in relation to functions such as operation, maintenance and testing in more fundamental terms. The emphasis is on the ‘key processes’ of the utility organisation. Each key process describes the kind of essential processes needed, how communication between various groups and departments is to be performed and what kind of instructions and forms must be used.

The system of key processes enhances the utility’s self-assessment capability. The management processes were implemented as a ‘first generation’ quality system in the late eighties and the system was improved in the early nineties to produce an integrated quality management system (in accordance with the IAEA codes and guides) incorporating a process-based approach. The management system comprises all the main processes in the plant: Management & Organisation, Training, Operations, Nuclear Fuel Management, Chemistry, Maintenance, Radiation Protection, Radwaste Treatment, Procurement, Configuration Management, Environmental Management, Industrial Safety, Security, Emergency Planning & Preparedness and Auditing.

The associated management procedures describe not only tasks and responsibilities, but also the input-documents (instructions, periodical programmes, checklists and specifications) to be used and the output-documents (forms and reports) to be generated.

The Operations process covers all activities in the operations field and their interfaces with other processes (like Maintenance, Chemistry and Fuel Management), for example:

- plant status control, Technical Specifications;
- work-order process, work licensing procedure;
- (functional) surveillance testing;
- surveillance rounds;
- event procedures, EOPs;
- event reporting;
- procedures for taking the plant to shut-down;
- procedures for start-up of the plant.

The Maintenance process covers all activities in the maintenance field, including interfaces with other processes (like Operations and Procurement), for example:

- preventive maintenance programmes, ISI programme, calibration & test programmes;
- ageing management;
- preparation and execution of maintenance tasks, work-order system;
- maintenance reporting.

The KFD checks the use of instructions and forms during its regular inspections. The quality assurance system for each key process is verified during audits (carried out by the LH, the KFD or a third party). As already stated in the text on Article 13, the quality assurance system will be replaced in the near future by a new system based on NVR-GS-R-3.

According to NVR NS-R-2 (Safety of NPPs: Operation), any non-routine operation which can be planned in advance and any test or experiment will be conducted in accordance with a prescribed procedure to be prepared, reviewed and issued in accordance with established procedures in order to ensure that no operational limit and condition is violated and no unsafe condition arises. However, should this operation nevertheless lead to an unexpected violation of one or more operational limits and conditions, standing orders shall instruct the personnel supervising or operating the controls of the plant to comply with the operational limits and conditions and consequently to bring the plant back into a safe condition. It shall be demonstrated that there is a definite need for the test or experiment and that there is no other reasonable way to obtain the required information.

Programmes and procedures for maintenance, testing, surveillance and inspection of structures, systems and components important to safety have been prepared and implemented, as a result of Periodic Safety Reviews as mentioned in Article 14. Especially the LTO programme will lead to changes in these programmes. The following main provisions in the new LTO-licence are aimed at these programmes:

- requirement to adapt the organisation, procedures, administration and competenses, knowledge and behaviour of the personel with respect to ageing managemen
- requirement to adapt the programmes of maintenance, surveillance and inservice inspection
- amongst others the first two requirement shall be based on outcomes of the ageing management review, the evaluation of the Safety Factors “Organisation, Management System and Safety Culture” and “Human Factors” and the recommendations and suggstions of the SALTO mission of 2012.
- the LH shall ensure that by 1-1-2014 all LTO-related active components are part of the programmes of maintenance, ISI or surveillance.

The KFD supervises the implementation of the requirements of the LTO-licence.

19.(iv) Procedures for response to anticipated operational occurrences and accidents

Licence Holders have to satisfy the requirements of NVR GS-G-2.1[51] (Requirements for operation) and NVR-NS-G-2.15 (Accident Management).

The Borssele NPP has developed a comprehensive set of procedures to enable it to respond to anticipated operational occurrences and accidents. Simpler malfunctions are the subject of event-based instructions and procedures. Emergency situations are dealt with by symptom-based Emergency Operating Procedures (EOPs). Severe Accident Management Guidelines (SAMG) have been introduced. These are intended to provide guidance on accidents involving core damage and potential radioactive discharges into the environment.

The Borssele NPP LH follows the approach adopted by the Westinghouse Owners Group (WOG), both for EOPs and SAMG. The severe accident management guidance defines priorities for operator actions during the various stages of a core melt process, sets priorities for equipment repairs and establishes adequate lines of command and control. Care has been taken to tailor the WOG approach to the particular characteristics of this Siemens/KWU station. The LH has extended the existing EOPs and SAMGs with non-power procedures not available in the generic WOG package. After the Fukushima event these procedures have been extended further to be able to deal with Station Black-out during non power situations.

Both operators and staff are given frequent training in the use of emergency operating procedures. This takes the form of courses on the full-scope simulator located in Essen, Germany, and emergency exercises at the plant. A data link for the process computer has been created between the plant and the simulator to enable calculating real time accident progression data in the phases before core melt. to be be monitored during an exercise by the staff at the plant. This simulator process data data can also be transferred in real time to the KFD in The Hague and to the severe accident support centres of AREVA. It is also possible to transfer the process data of the plant itself through these data links to the KFD and to AREVA.

In the event of a severe accident, support is also available from the plant vendor, AREVA (formerly Framatome ANP and Siemens/KWU), which operates a round-the-clock service to assist affected plants and is available on call.

The supervision of safety relevant changes of important operating procedures by KFD will be further improved starting with the procedures that will be developed or changed based on the lessons learned from Fukushima.

19.(v) Engineering and technical support

The Borssele NPP LH has built up considerable expertise and is able to manage most safety-related activities. The staff is suitably qualified and experienced as stated in Article 11.2. In addition, the LH works in close collaboration with the plant vendor and other qualified organisations in the Netherlands and abroad. Among the companies and institutions contracted are the VGB, AREVA, NRG, Belgatom, and AVN.

Procedures have been developed and implemented for contractors. For instance, contractors are made familiar with the installation and normal working procedures by showing them training films explaining ‘work practices’. [beide update EPZ]

The supervision of KFD on the subject of qualification of technical support organisations for the LH has been limited mainly to the contractors acting on site during refueling or modifications.

[51] Arrangements for Preparedness for a Nuclear or Radiological Emergency

Since the Regulatory Body (RB) has a small staff, it frequently uses outside support for its assessments and inspections. For more information on the organisation of contracted support for the RB, refer to the text on Article 8 'Regulatory Body', and more specifically section 8.1.i.

The RB also benefits from input from the EU Clearinghouse for the evaluation of incidents. The inspectorate branche of the RB is one of the founding partners of the EU Clearinghouse.

The German phase-out will reduce the possibilities for both operator as well as RB to contract support from German companies and institues. The post-Fukushima National Action Plan addresses this issue. Refer to the text on Article 8 for more information (specifically section 8.1.g, 'Future and current challenges for the Regulatory Body').

For current staffing at the RB, refer to the text on Article 8.

19.(vi) Reporting of incidents

An incident-reporting system is a condition of the licence and is in operation for all existing nuclear installations. The system is based NVR NS-G-2.11, 'A System for the Feedback of Experience from Events in Nuclear Installations'.

The criteria for reporting to the regulatory authorities are described in the Technical Specifications. Depending on its nature, an event must be reported to the KFD:

- category (a) events have to be reported within eight hours by telephone and within 14 days by letter, or
- category (b) events have to be reported within 30 days by letter (this type of incident is normally also reported the same day by telephone).

Examples of category (a) events are:
Violations of the licence and the Technical Specifications limits, exposure to high doses (as referred to in the Bkse), activation of the reactor protection system leading to reactor scram, ECCS actuation and/or start of the emergency power supply (diesel generators).

Examples of category (b) events are:

- (Minor) leakages of fuel elements, leakage of steam generator tubes and of the primary system, non-spurious activation of the reactor protection system and events causing plant staff to receive a dose in excess of 10 mSv.
- Degradation of safety systems or components, and events induced by human activities or natural causes that could affect the safe operation of the plant.

In exceptional situations, i.e. if there is a major release of radioactive material or if a specified accident occurs (> 2 on the International Nuclear Event Scale, INES), the NPP is obliged to notify the National Emergency Centre directly. Depending on the nature of the accident, various government bodies are alerted. The inspectorate branche of the RB (KFD) is always alerted. Further information is given in the section on Article 16.

The inspectorate branche of the RB (KFD) houses the national officer for INES (International Nuclear Event Scale) and also the national coordinator IRS (Incident Reporting System) and IRSRR (Incident Reporting System for Research Reactors). Also KFD is responsible for the newer systems like FINAS and the NEA system for the collection of events during construction of a new nuckear installation.

Reports from the LH are first handled by the KFD inspector on duty. The inspector prepares, if necessary supported by colleagues, a first action or reaction to theLH. Next KFD experts work further on the report and take the suitable actions like requiring further action from the LH, international reporting and determining the INES scaling. KFD prepares an annual report on nuclear incidents to the Dutch Parliament and monitors the progress made by the LHs on the follow-up of incidents.

19.(vii) Sharing of important experience

Power plant (Borssele)

A standing task force at the nuclear power plant assesses incidents. The establishment of this task force is required under the licence. A second standing task force assesses ageing issues. It is recognised that the effects of ageing may pose technical challenges in the future, and that expertise and adequate data on operational history need to be available to cope with these potential problems. The NPP operates databases for its own use and these contain data on incidents from various sources, including the plant itself, WANO, IAEA and OECD/NEA IRS, IAEA News, VGB, AREVA, USNRC, GRS, etc.

Borssele reports relevant incidents to WANO and VGB. Operational measures obtained from WANO (Good Practices and Performance Objectives & Criteria) are implemented by Borssele NPP.

Information is regularly exchanged on a bilateral basis with operators in neighbouring countries, plus a number of other countries. Personnel of Borssele actively participates in WANO-, OSART-, AMAT- and other missions at foreign NPPs.

Research reactors and fuel cycle facilities (uranium enrichment and nuclear waste storage)

These facilities have organisational structures and expertise to share important experience between facilities. All of them have standing task forces for the assessment of incidents.

All facilities have specific international contacts within their scope of work.

The Regulatory Body

There are frequent regulatory contacts with many European countries and the USA. Within the framework of the NEA, the Netherlands participates in a working group dealing on a regular basis with operational events. The Netherlands is a member of the OECD/NEA and IAEA mechanisms for sharing key operational experience, the Working Group on Operational Experience (WGOE) of the OECD/NEA Committee for the Safety of Nuclear Installations (CSNI), and the international incident reporting systems (IAEA and OECD/NEA IRS, IRSRR and FINAS). Further the Netherlands is a member of the EU Clearing House.

The RB closely monitors the lessons learned from the Fukushima Daiichi accident (special project created). The inspection branche of the RB also contributed to the NEA/CNRA Special Task Group Fukushima Lessons Learned. It also participates in international expert teams for nuclear topics. A recent example is the international review teams related to the Doel-issue (flaws in reactor vessel).

19.(viii) Generation and storage of radioactive waste

The licence for the NPP state that the provisions of the NVRs must be satisfied. On the issue of radioactive waste management, NVR NS-R-1 (Safety of NPPs: Design) requires adequate systems to be in place for handling radioactive solid or concentrated waste and for storing this for a reasonable period of time on the site. The LH has such systems at its disposal and keeps records of all radioactive waste materials, specifying the type of material and the form of packaging.

The Dodewaard NPP has sent all fuel for reprocessing at Sellafield and has sent all easy removable waste to COVRA. The plant has been transformed into a safe enclosure. This building will contain the remaining materials for 40 years (until 2046) in order to minimise both the activity and the volume of the waste eventually to be transported to COVRA.

The LH of the Borssele NPP has adopted a written policy of keeping the generation of radioactive waste to the minimum practicable. One of the measures taken to this end is ensuring that the chemistry of the primary system is adequate, in order to reduce the generation of corrosion particles which may be activated. Internal procedures are used to achieve optimum water quality.

Solid waste from the site is transported in accordance with conditions set by the RB. Under these conditions, the LHs have to draw up a timetable for the transportation of radioactive waste to the COVRA interim storage facility for all radioactive waste produced in the Netherlands. The LHs must send a list to the RB at the beginning of each year, stating how much radioactive waste is in storage on-site and how much waste has been transported to COVRA over the previous year.

The NPP's waste management programmes stipulate that general internal radiation protection procedures must be observed so as to satisfy the radiation protection principles, as well as NVR NS-G-2.7 (Radiation Protection and Radioactive Waste Management in the Operation of NPPs). The latter includes the treatment and storage of spent fuel and waste directly related to operation (taking conditioning and disposal into account). The RB is informed, as described in the section on Article 15.1.

Appendix 1 SAFETY POLICY AND SAFETY OBJECTIVES IN THE NETHERLANDS

a. Safety objectives

The IAEA has established standards for safety to protect health and minimize danger to life and property. Many Member States have adopted these as the global reference, to achieve a high level of protection for people and the environment. The IAEA has produced and is continuously updating its Safety Standards Series.

In the Netherlands, safety policy in the nuclear field is based on the following overarching fundamental safety objectives that have been derived from IAEA safety standards.

The general nuclear safety objective:

To protect individuals, society and the environment from harm by establishing and maintaining in nuclear installations effective defences against radiological hazards.

The general nuclear safety objective is supported by two complementary safety objectives:

The technical safety objective:
To take all reasonably practicable measures to prevent accidents in nuclear installations and to mitigate their consequences should they occur; to ensure with a high level of confidence that, for all possible accidents taken into account in the design of the installation, including those of very low probability, any radiological consequences would be minor and below prescribed limits; and to ensure that the likelihood of accidents with serious radiological consequences is extremely low.

The radiological safety objective:
To ensure that in all operational states radiation exposure within the installation or due to any planned release of radioactive material from the installation is kept below prescribed limits and as low as reasonably achievable, and to ensure mitigation of the radiological consequences of any accidents.

These objectives have been adopted from the IAEA report entitled 'The Safety of Nuclear Installations – Safety Fundamentals', Safety Series No 110. This document is referenced in the NVRs that are referenced in the licences of among others the NPP Borssele (NVR NS-R-1 and NVR NS-R-2). The Regulatory Body is well aware that since 2006, this document has been superseded by SF-1, 'Fundamental Safety Principles'[52] of the IAEA Safety Standards Series. Refer to section **c** of this Appendix for ongoing regulatory developments that will properly embed SF-1 in the regulatory framework.

a.1. Technical safety objective

As discussed in the sections on the various articles of the Convention, extensive rules and regulations, derived from the IAEA Safety Standards, have been defined and formally established. No licence is issued unless the applicant satisfies the regulations. Inspections are carried out to monitor compliance with the rules. Priority is given to safety, and the Licence Holder (LH) is aware of its responsibility for

[52] SF-1 supersedes and replaces three older guides: SS No.110 'The Safety of Nuclear Installations' (1993), SS No.111-F 'The Principles of Radioactive Waste Management' (1995) and SS No.120 'Radiation Protection and the Safety of Radiation Sources' (1996).

safety. Periodical Safety Reviews (PSRs) are conducted, to ensure that account is taken of new safety insights.

The Dutch Regulatory Body (RB) therefore believes that all echelons of the defence-in-depth principle have been preserved, so that there is a low probability of accidents and, should accidents occur, the probability of radiological releases is very low. Even in the case of accidents beyond the design basis – those that might lead to serious radiological releases – measures have been taken to further reduce their probability and to mitigate the consequences should they occur. The follow up of the 'stress test' includes measures that will further increase the safety margins.

In the light of these measures, the technical safety objective has been fulfilled.

a.2. Radiological safety objective

Under the radiological safety objective, the formal legal limit for the radiation levels to which members of the public are exposed is based on the Euratom 1996 Basic Safety Standards. The government has also formulated an environmental risk policy, which has to be taken into account.

b. Dutch environmental risk policy

The concept of risk management and risk assessment was first introduced into Dutch environmental policy in the 1986-1990 Long-Term Programme for Environmental Management. The concept was reassessed following debates in Parliament. As part of the Dutch National Environmental Policy Plan[53], the Minister of Housing, Spatial Planning and the Environment, the Minister of Economic Affairs, the Minister of Agriculture, Nature and Food Quality, and the Minister of Transport, Public Works and Water Management set out a revised risk management policy in a document called 'Premises for Risk Management; Risk Limits in the Context of Environmental Policy'[54]. Next, a separate document was issued dealing with the risk associated with radiation: 'Radiation Protection and Risk Management; Dutch Policy on the Protection of the Public and Workers against Ionising Radiation'[55]. These documents still constitute the basis for government policy on risk management.

The Nuclear Installations, Fissionable Materials and Ores Decree (Bkse) has been amended to incorporate this risk policy in the licensing process for nuclear installations. Risk criteria are explicitly included as assessment principles for licences to be granted to nuclear power plants. The outcomes of a level-3 PSA must be compared with these risk criteria and objectives.

This concept of environmental risk management incorporates the following objectives and steps:
- verifying that pre-set criteria and objectives for individual and societal risk have been met. This includes identifying, quantifying and assessing the risk;
- reducing the risk, where feasible, until an optimum level is reached (i.e. based on the ALARA principle);
- maintaining the risk at this optimum level.

Normal operation

The dose limit due to normal operation of installations consists of a maximum total individual dose of 1 mSv in any given year for the consequences of all anthropogenic sources of ionising radiation (i.e. NPPs, isotope laboratories, sealed sources, X-ray machines, etc). For a single source, the maximum individual dose has been set at 0.1 mSv per annum. In addition, as a first step in the ALARA process, a general dose constraint for any single source has been prescribed at 0.04 mSv per annum.

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[53] Lower House of the States General, 1988-1989 session, 21137, Nos. 1-2, The Hague 1989
[54] Lower House of the States General, 1988-1989 session, 21137, No. 5, The Hague 1989
[55] Lower House of the States General, 1989-1990 session, 21483, No. 1, The Hague 1990

Design-basis accidents

The public health risks due to incidents or accidents in the design-basis area are also bound to the criteria of the individual risk concept. However, a conservative deterministic analysis of the respective design-basis accidents is more effective than a PSA, which is based on a probabilistic approach, for the purpose of ensuring that the engineered safety features of a particular NPP are adequate. There are a number of reasons why a conservative, deterministic approach has certain advantages over a probabilistic approach:

Design-basis accidents are postulated to encompass a whole range of related possible initiating events that can challenge the plant in a similar way. These individual related initiating events do not therefore need to be analysed separately.

It is much easier to introduce the required conservatism. With a probabilistic approach, uncertainty analyses need to be performed to calculate confidence levels.

By definition, design-basis accidents are events that are controlled successfully by the engineered safety features. Hence, they do not result in core melt scenarios, and are considered in a PSA as being 'success sequences'. The related radioactive releases are negligible compared with the uncontrolled large releases associated with some of the beyond-design-basis accidents. In other words, a general 'state-of-the-art' PSA, which focuses primarily on core melt scenarios and associated large off-site releases, does not take account of the consequences of design-basis accidents.

Clearly, the above dose and risk criteria are not suitable for use as rigid criteria in the conservative and deterministic approach used in traditional accident analyses. A separate set of safety criteria has therefore been formulated, as required by NVR NS-R-1[56].. The set of criteria is defined in the Nuclear Installations, Fissionable Materials and Ores Decree (Bkse, refer to text on Article 7 of the CNS). The criteria are:

Frequency of event F per annum	Effective dose (H_{eff}, 50 years) in mSv	
	Adult	Child
$F \geq 10^{-1}$	0.1	0.04
$10^{-1} > F \geq 10^{-2}$	1	0.4
$10^{-2} > F \geq 10^{-4}$	10	4
$F < 10^{-4}$	100	40

An additional limit of 500 mSv thyroid dose (H_{th}) must be observed in all cases.

Correspondingly the provisions concerning the dose related to normal operation as a first step in the ALARA process, a general dose constraint has been prescribed at values of 40% of the above mentioned.

Major accidents

For the prevention of major accidents, the maximum permissible level for the individual mortality risk (i.e. acute and/or late death) has been set at 10^{-5} per annum for all sources together and 10^{-6} per annum for a single source.

As far as major accidents are concerned, both the individual mortality risk and the group risk (= societal risk) must be taken into account. In order to avoid large-scale disruptions to society, the probability of an accident in which at least 10 people suffer acute death is restricted to a level of 10^{-5} per annum. If the number of fatalities increases by a factor of n, the probability should decrease by a

[56] NVR NS-R-1 'Veiligheid van kernenergiecentrales: veiligheidseisen voor het ontwerp', which is an adaptation of IAEA Safety Requirements Safety Standard Series No. NS-R-1, 'Safety of Nuclear Power Plants: Design Safety Requirements'.

factor of n^2. Acute death means death within a few weeks; long-term effects are not included in the group risk.

In demonstrating compliance with the risk criteria, it has to be assumed that only the usual forms of preventive action (i.e. fire brigades, hospitals, etc.) are taken. Evacuation, iodine prophylaxis and sheltering may not, therefore, be included in these measures.

This risk management concept is used in licensing procedures for nuclear installations and all other applications of radiation sources. Guidelines for the calculation of the various risk levels have been drafted for all sources and situations. In principle, the calculations must be as realistic as possible (i.e. they should be 'best estimates').

For NPPs, this means that the level-3 PSA plays a leading role in the verification process. Specific procedural guidelines have therefore been drafted in the Netherlands for the conduct of full-scope PSAs. The level-1 PSA guide is an amended version of the IAEA SSG-3 'Development and Application of Level 1 Probabilistic Safety Assessment for NPPs' and the level-2 guide is based on IAEA SSG-4 'Development and Application of Level 2 Probabilistic Safety Assessment for NPPs'.

The procedural guide for level-3 PSAs is a specifically Dutch initiative, in which the COSYMA code for atmospheric dispersion and deposition is used. It gives instructions on the pathways which have to be considered, the individuals (i.e. critical groups) for whom the risks should be assessed and the type of calculations which should be performed. It also describes how the results should be presented.

Since it has been recognised that PSAs produce figures that can be used as a yardstick in safety decisions, a number of countries have developed probabilistic safety criteria. The Regulatory Body in the Netherlands has taken note of the INSAG-3 safety objective, i.e. the maximum acceptable frequency for core damage currently is 10^{-5} per annum for new NPPs and 10^{-4} per annum for existing NPPs.

In addition, the objective of accident management strategies should be that the majority of potential accident releases will not require any immediate off-site action, such as sheltering, iodine prophylaxis or evacuation. This means that the dose to which members of the public are exposed in the first 48 hours after the start of the release should not exceed 10 mSv. The PSA can help in fixing these figures.

Minimisation of residual risk
The Rasmussen study (WASH-1400) showed that risk was not dominated by design-basis accidents, as was made very clear by the TMI-2 incident and the Chernobyl accident. For this reason, the RB felt it would be useful to enhance the reactor safety concept, which had to that date been based mainly on deterministically defined events such as a large-break LOCA, by incorporating certain risk elements. In addition to the radiological hazard criteria already mentioned, it was decided to require the LH to make a reasonable effort to minimise the risk.

c. Ongoing regulatory developments: Dutch Safety Requirements (DSR)

The Netherlands has brought Council Directive 2009/71/EURATOM of 25 June 2009 on nuclear safety into force[57] on July 22, 2011. The safety objectives of the Directive cover those of the Nuclear Safety Convention and are in some regards more specific and have a larger scope.

The Directive refers to amongst others IAEA SF-1 for its appropriate implementation by the member states. The Netherlands thus already observes the principles of SF-1.

[57] Regulation of the Minister of Economic Affairs, Agriculture (EL&I) and Innovation and the Minister of Social Affairs and Labour of 18 July 2011, No WJZ/11014550, concerning the implementation of Directive No 2009/71/Euratom of the Council of the European Union 25 June 2009 establishing a Community framework for nuclear safety of nuclear installations (PB EU L 172/18).

The RB is finishing the new ‘Dutch Safety Requirements’ (DSRs) for new water cooled reactors. An incentive for its development are the past and present plans for nuclear new build. The DSR provides for clear requirements for nuclear power plants and research reactors covering the lifetime of the plant.

There is a separation between technical requirements and requirements for management and organisation (M&O). Therefore there are two DSR documents.

The DSR documents are based on the IAEA Safety Fundamentals, several Safety Requirements guides and some Safety Guides, European council directive 2009/71/EURATOM, safety objectives published by WENRA and some other reputed sources. An annex to the technical DSR is dedicated to Research Reactors (RRs). The DSR steps up the safety requirements for new reactors. As an example, the maximum acceptable frequency for core damage is set at 10^{-6} per annum for new NPPs. The DSR may become applicable to existing reactors as far as reasonably achievable and in line with the objective of continuous improvement.

The DSR will contribute to establishing a comprehensive regulatory framework..

Figure 2 shows the anticipated position of the DSR in the regulatory framework..

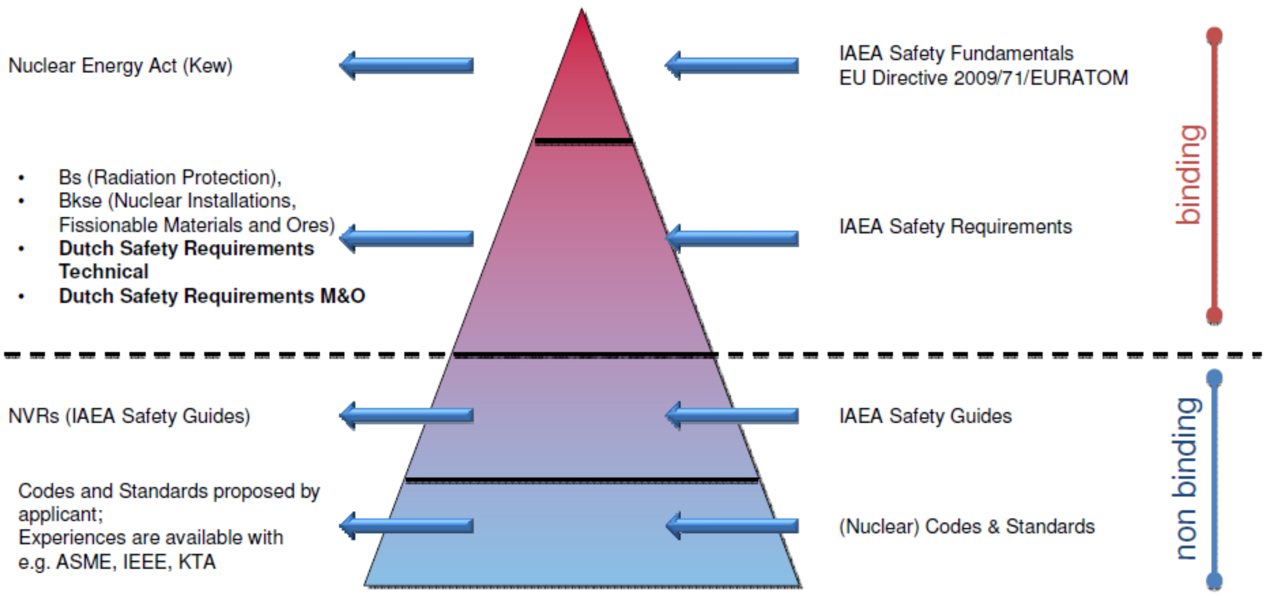


Figure 2 Anticipated position of the DSR in the regulatory framework

The technical requirements part of the DSR has seven main chapters and six annexes. The most important chapters of the technical DSR are the chapters 2 and 3. The structure and content of the DSR is explained below to some detail.

Ch 1 Fundamental principles

The fundamental safety objective is to protect people and the environment from harmful effects of ionising radiation throughout the entire lifetime of a nuclear reactor: design, construction, commissioning, operation, decommissioning and dismantling. Safety measures, security measures and measures for accounting for, and control of, nuclear material shall be designed and implemented in an integrated manner in such a way that they do not compromise one another.

Ch 2 Technical safety concept

The safety objectives for new power reactors recommended by the Western European Nuclear Regulators Association (WENRA) have been implemented in the technical safety concept. Refer to Table 4 of the present CNS-report for an overview of the technical safety concept. Also some preliminary lessons learned after Fukushima have been incorporated; future lessons will be incorporated in succeeding updates. Chapter 2 of the DSR addresses five main topics:

- Concept of 'Defence in Depth' (DiD), with levels of defence 1, 2, 3a, 3b, 4 and 5 (refer to Table 4). The levels of defence shall be independent as far as practicable.
- Concept of multi-level confinement of radioactive inventory, with barriers and retention functions and their links to the various levels of defence.
- Concept of fundamental safety functions; reactivity control, core cooling and confinement of radioactive materials. For all levels of defence, the DSR describes the requirements that need to be fulfilled in relation to these safety functions – where applicable.
- Concept of Protection against internal and external events. There shall be no failure of safety systems due to external events. With internal hazards, only the affected systems are allowed to fail. Combinations of hazards shall be taken into account.
- Radiological safety objectives that have to be complied with. The DSR requires that large releases shall be practically eliminated. Only limited (in area and time) protective measures shall be needed at DiD level 4.

Implementation of the technical safety concept results in practical elimination of phenomena leading to large and early releases (level of defence 4).

Ch 3 Technical requirements

Chapter 3 of the DSR details the technical requirements that when fulfilled will contribute to implementing technical safety concept of chapter 2 of the DSR. Chapter 3 lists many requirements for among others design of the reactor core and shut down systems, fuel cooling in the core, reactor coolant pressure boundary, buildings, containment system, I&C, control rooms etcetera.

Various requirements have been stepped up in comparison to current requirements, like those for redundancy.

Ch 4 Postulated operating conditions and events

A plant specific list of events has to be created. Chapter 4 of the DSR outlines what kind of events need to be considered in relation to the various DiD levels. It also addresses events involving multiple failure of safety installations. In chapter 4 of the DSR, also reference is made to the annex-1 of the DSR with postulated events that as a minimum need to be considered.

Ch 5 Requirements for the safety demonstration

Chapter 5 of the DSR details the requirements for the 'safety demonstration' (safety case). The safety case, to be documenten in a Safety Analysis Report (SAR) shall cover all phases during the lifetime of the plant. Reference is made to IAEA Safety Standards for specifications for the SAR. Deterministic as well as probabilistic analysis (including level-3) are required for the safety case.

Ch 6 Requirements for the operating rules

Chapter 6 of the DSR details what kind of information shall be documented for the operating rules. More specific specifications are given in annex-4 of the DSR. The DSR also details requirements regarding accessibility of documentation, updating of documents and associated procedures.

Ch 7 Requirements for the documentation

This chapter states that "*The licensee shall have available a systematic, complete, qualified and upto-date documentation of the condition of the nuclear power plant*.". For details the DSR refers to its annex-4.

Table 4 Technical safety concept in DSR, based on WENRA guidance

Levels of defence in depth	Associated plant condition categories	Objective	Essential means	Radiological consequences
Level 1	Normal operation	Prevention of abnormal operation and failures	Conservative design and high quality in construction and operation, control of main plant parameters inside defined limits	Regulatory operating limits for discharge
Level 2	Anticipated operational occurrences	Control of abnormal operation and failures	Control and limiting systems and other surveillance features	
Level 3[1]	Level 3.a Postulated single initiating events	Control of accident to limit radiological releases and prevent escalation to core melt conditions[2]	Reactor protection system, safety systems, accident procedures	No off-site radiological impact or only minor radiological impact
	Level 3.b Postulated multiple failure events		Additional safety features, accident procedures	
Level 4	Postulated core melt accidents (short and long term)	Control of accidents with core melt to limit off-site releases	Complementary safety features to mitigate core melt, Management of accidents with core melt (severe accidents)	Limited protective measures in area and time
Level 5	-	Mitigation of radiological consequences of significant releases of radioactive material	Off-site emergency response Intervention levels	Off-site radiological impact necessitating protective measures

The DSR has six annexes, of which annex-6 is dedicated to requirements for Research Reactors:

Annex 1: Postulated events

This annex to the DSR defines events assigned to the levels of defence 2 to. It presents generic event lists for pressurized water reactors (PWRs) and boiling water reactors (BWRs). Especially for these events it shall be demonstrated in accordance with the

"Annex 4: Requirements for the safety demonstration and documentation" that the safety-related acceptance targets and acceptance criteria applicable on the different levels of defence in depth are achieved and maintained.

Annex 2: Requirements for provisions and protection against hazards

This annex to the DSR-document, provides additional requirements to the design in providing protection against internal and external hazards.

Annex 3: Basic principles of the application of the single failure criterion and for maintenance

This annex to the DSR document provides requirements regarding the application of the single failure concept and requirements for maintenance. Notable requirements are:

- (n+1) for I&C on level of defence 2;
- (n+2) level of defence 3a;
- (n+1) for active parts on level of defence 3b and 4 according to WENRA / RHWG.

Annex 4: Requirements on the safety demonstration and documentation

This annex to the DSR-document, provides additional requirements regarding the safety demonstration and associated documentation.

Annex 5: Definitions

Annex 6: Requirements for research reactors

Annex 6 provides guidance for the appropriate application of the DSR to research reactors:

- Description of the systematic approach of the method;
- Matrix of all requirements of the 'Safety Requirements for Nuclear Reactors' and proposal of appropriate application.

Each research research reactor is unique and will have to be individually regulated. The annex present a systematic approach to categorization of the research reactor according to the specific hazard potential.

Appendix 2 THE ROLE OF PSAs IN ASSESSING SAFETY

a. History of the role of PSAs and their role in the Netherlands

As long as a PSA is comprehensive in its scope (including shut-down states, internal and external events, etc.) and is state-of-the-art, it will be an instrument that can be used to roughly demonstrate compliance with safety criteria, thereby recognising the uncertainty and imponderability of a large number of relevant matters. In that way it can be used as a decision-making tool, without the need for an absolute belief in the numbers yielded.

Dutch nuclear power plants (NPPs) launched their PSA programmes in 1989. The main objective was to identify and assess relatively weak points in the design and operation of the power plants, and thus to facilitate the design of accident management measures and to support back-fitting. An assessment of source terms, public health risks, etc., was regarded as unnecessary at that time.

Major modification and back-fitting programmes were announced at around the same time, partly as a result of the accident at Chernobyl. A back-fitting requirement or ‘rule’ was formulated for the existing NPPs. The requirement addresses the design-basis area, but also the beyond-design-basis area and associated severe accident issues. The ‘back-fitting rule’ also requires 10-yearly safety reviews. This requirement was included in the operating licences issued for both plants. At that time an important part of these 10-yearly safety reviews was a level-1 ‘plus’ PSA (level 1+).

In the early 1990s, these level-1+ PSAs were expanded to full-scope level-3 PSAs, including internal and external events, power and non-power plant operating states, and human errors of omission and commission. The PSAs were expanded partly in order to comply with the requirement that the studies should be ‘state-of-the-art’ (i.e. including non-power plant operating states and human errors of commission), and partly because of the licensing requirements associated with the ongoing modification programmes (i.e. an environmental impact assessment had to include a level-3 PSA).

b. Guidance for and review of the PSAs

Establishing guidelines for PSA

At the start of the Dutch PSA programmes in 1988/1989, there were no national PSA guidelines. In addition, both the Licence Holders (LHs) and the Regulatory Body (RB) had very little experience in developing a complete PSA for a nuclear power plant. For this reason, both the LHs asked foreign contractors to develop their PSAs and a the same time transfer knowledge. Mainly regulatory guidance from the USA was used at that time. The development was further accompanied by a series of IAEA missions. In the early 1990s, in a combined effort, Dutch institutes produced PSA-3 guidelines.

c. Living PSA applications

After the PSA relating to the 1994 modification project had been completed, the focus shifted towards Living PSA (LPSA) applications. The new licence for the modified Borssele plant required the LH to have an operational Living PSA.

The PSA for the Borssele NPP is updated yearly. This means that both plant modifications and updated failure data are included in the PSA model. The operator, EPZ, is using the Living PSA for many applications:

- Evaluation of modification proposals (design review);
- Licensing support;
- Technical Specification optimisation;
- Optimisation of the maintenance programme;
- Optimisation of periodic testing and surveillance;

- Shut-down period configuration evaluation and optimisation;
- Day-to-day configuration evaluation and optimization;
- Event analysis;
- Development of Severe Accident Management Guidelines (SAMGs);
- Use of PSA source terms for emergency planning & preparedness.

Below a number of the applications are explained to some detail.

Evaluation of modification proposals (design review)
In 1993 the first 10-yearly Periodic Safety Review (PSR) took place. The PSR resulted in a major modification program. Although the PSA was not yet finalised, it was felt that the PSA could play a large role in the optimisation and evaluation of the deterministic safety concept, the study of alternative solutions and in the licence renewal (Environmental Impact Assessment).

The established modifications reduced the TCDF from 5.6 10^{-5}/year to 2.8 10^{-6}/year.

In 2003 the second PSR took place. The PSA played an important role in this PSR. All issues were weighed against deterministic criteria (Low, Medium and High impact) and the risk significance (TCDF and Individual Risk (IR)).

Technical Specification optimisation
Borssele NPP has optimized the Allowed Outage Times (AOTs) and inspection intervals. US-NRC Regulatory Guide 1.177 was used as the base for the application, amended to reflect the situation in the Netherlands. The Borssele NPP has modified the acceptance criteria from this guide by lowering them with a factor of 10.

Other boundary values that have been used in the application include:
- For optimisation of AOTs the LH has adopted a value of 5.10^{-8} for ΔTCDF x AOT
- TCDF shall always < 1. 10^{-4}/year.

Apart from the PSA an expert team participated in the project to address deterministic views, like preservation of defence in depth and safety margins. The team also took into account items like necessary maintenance and repair times, adequacy of spare parts, availability and duration of supply of components on the market.

Shut-down period configuration optimisation (use of risk monitor)
In the figure below an example is given of the result of the outage planning for the refuelling outage in 2004.

One of the main objectives for the use of the risk monitor for configuration control is to minimise the TCDF increase as a result from planned component outages by:
- Mastering simultaneous component outages
- Rescheduling component outages with high TCDF impact in a certain plant operating state to an operating state where the component outage has a lower impact,
- Reduction of duration of the refuelling outage.

As a decision yardstick several numerical criteria have been developed by the LH:
- Cumulative TCDF increase caused by planned and unplanned component outages < 5%
- Cumulative TCDF increase caused by planned component outages < 2 %.
- Instantaneous TCDF shall never exceed the value of 1. 10^{-4} / year.

Day-to-day configuration evaluation
This application of LPSA must be stressed. The Borssele NPP is equipped with a high redundancy level. In many cases where a component is taken out of service, the technical specification AOT is not entered. In this area, the use of PSA is very useful. The cumulative delta-TCDF is used as a special performance indicator for this. EPZ aims to keep this indicator below 2% per annum in the case of scheduled maintenance (planned outages) and 5% for planned and unplanned outages combined.

Development of Severe Accident Management Guidelines (SAMGs)
The level-2 PSA demonstrated that SGTR events with a dry secondary side of the SG could cause the largest source terms and thereby, a large contributor to the public health risk (Source Terms up to 50% Cs and I). The most promising strategy was the scrubbing of the source term through the water inventory in the SGs. By installing extra pathways to keep the SGs filled with water (including flexible hose connection with the fire-fighting system) a factor 14 reduction in the magnitude of the source term (CsI and CsOH) could be achieved. A closer look at the MAAP4 results showed that the major effect was not the scrubbing effect, but by deposition of fission products on the primary side of the SG tubes. This deposition effect plays also a large role in other core melt scenarios such as ISLOCA.

When core damage in ATWS scenarios cannot be prevented, opening of the PORVs is suggested. Loss of primary inventory is much faster, but creation of steam bubbles will stop the fission process. Also induced SGTR is less probable because of lower primary pressure. In case induced SGTR cannot be prevented lower pressure still helps. Opening of the secondary relief valves is less probable in that case.

Use of PSA source terms for emergency planning & preparedness
In the unlikely event that a severe event occurs at the plant with a serious threat for an off-site emergency, the 16 defined source terms in the PSA of Borssele are used as input for the prognosis. These source terms are already included as default input data in the computer codes being used for forecasting the consequences.

For the definition of the planning zones for evacuation, iodine prophylaxis and sheltering, originally the PWR-5 source term from WASH-1400 (Rasmussen Study) was taken as a conservative reference source term. Because the dose criteria for evacuation, iodine prophylaxis and sheltering were lowered, a re-evaluation of the reference source term was done by RB together with the KFD. Doing nothing would have resulted in (emergency) planning zones becoming significant larger than before and also larger than actually needed. Therefore, a more realistic and Borssele NPP specific source term was developed, matching the existing planning zone.

d. Transition towards a more Risk-informed Regulation

The RB increasingly is confronted with design or operational changes which originate directly from, or are supported by arguments stemming from LPSA-applications at Borssele, and which require approval of the inspectorate of the RB, i.e. the KFD. Therefore the IAEA was asked in 1999 to advice the KFD in order to support this process. The focal points of this review are illustrated by questions like:
"*Are the LPSA-applications at the Borssele NPP state-of-the-art and sufficient, or should the operator do more*?", "*How should the KFD respond to these applications, given a small regulatory staff and possible short remaining lifetime of the Borssele NPP*?".

Among others the recommendations to the RB were:

- Develop a framework for the use of risk information in regulatory decisions. This should include the identification of objectives, description of the decision-making process and acceptance criteria, and clarification of how risk-informed decision-making is to be incorporated in the existing

regulations. Since developing such a framework may take considerable effort, they were suggested to review existing risk-informed frameworks, bearing in mind that acceptance criteria need to be developed for the specific situation in The Netherlands.
- The resources required for accomplishing risk-informed regulation depend on how much use will be made of this approach, however, the IAEA team suggested that, as a minimum, KFD should continue to allocate one person, having in-depth knowledge of the Borssele PSA, for PSA-related activities, and that all decision-makers should have some training in PSA.
- Finally, IAEA suggested the KFD to use the PSA to focus the regulatory inspection program on the more significant systems, components, and plant practices.

As a follow-up of this advice, the KFD cautiously defined a follow-up program/feasibility study in order to proceed towards a more risk-informed regulation. It was decided to take a step-by-step approach. Allthough in the meantime a number of risk informed decisions have been made, like as mentioned optimisation of Technical Specifications, the development of the RiR-regulation has not yet been successful for a number a reasons: capacity and priority setting at KFD, shifted priority at the NPP, loss of knowledge and experience by pensioning and changes in the organisation of the RB in the Netherlands.

Appendix 3 THE SAFETY CULTURE AT BORSSELE NPP

a. Introduction

Reference is made to the Borssele NPP policy document 2001-0914 rev.4 of 2004:
EPZ supports the intention in respect to safety culture as defined in the IAEA reports 75-INSAG-4, INSAG-12 and INSAG-15. The definition of the term safety culture reflects the way that the organisation is using people, resources and methods. It is the opinion of EPZ that the attitude, way of thinking, professionalism and alertness of every employee is of great importance to safety. EPZ shall take measures to maintain and promote these attitudes.

The policy document links up with descriptions of the organisation's 'main processes', as laid down in the Operating Instructions and defined as:

- management and organisation,
- personnel and organisation,
- configuration management,
- operations,
- maintenance.

The main processes form the basis on which the annual departmental plans are drawn up. The policy document is linked to the business plan, which also discusses financial aspects.

b. Introduction of safety culture programme

In 1996 EPZ launched a safety culture programme for the Borssele NPP. This is an ongoing programme in which new activities are defined every year to improve the safety culture of the personnel of the NPP. These include, for example:

- Introduction of the STAR principle to all employees, where STAR means 'Stop, Think, Act and Review'.
- Introduction of the topic of safety culture into toolbox meetings,
- Introduction of work practices sessions into operations and maintenance refresher courses,
- Introduction of the principle of management on the floor and regular management rounds,
- Management training on safety culture,
- Special focus on safety culture when performing root-cause event analyses,
- Involvement of staff in peer reviews of international nuclear power plants,
- Production of 'work practices' training films for contractors and NPP staff.

Below the above mentioned activities are explained to some detail.

Introduction of the STAR principle to all employees
All Borssele NPP staff members have attended a 2-hour training session explaining the STAR principle using day-to-day examples. The STAR principle has been developed to improve normal work practices.

Introduction of the topic of safety culture into toolbox meetings
All operations and maintenance employees are required to attend monthly toolbox meetings at which industrial and radiological safety issues are discussed. Safety culture issues have now also been introduced. These include the STAR principle, the system of work licences, the nuclear safety tagging system, etc.

Introduction of work practices sessions into operations and maintenance refresher courses
Refresher courses now include a full-day training session at which work practices are discussed on the basis of undesired events in the past year. There is a special focus on how to handle safety when attention seems to be totally absorbed by time issues. The main message here is: (nuclear) safety first; when there is any doubt, immediately inform management about the issue, so that no unnecessary time will be lost.

Introduction of principle of management on the floor and regular management rounds
An important aspect of safety culture is the communication of 'management expectations'. The best way to communicate these expectations is by the presence of management on the floor, e.g. workers must be in close contact with management in normal working situations, to avoid interpretation problems. This is difficult to do because managers tend to lead busy lives, and their presence on the floor does not have top priority. Special programmes and requirements are needed to force them to make time for it.

At the Borssele NPP, the advancement of the management-on-the-floor approach is being combined with the introduction of regular management rounds for all managers. The management rounds focus on the installation. During them, all deficiencies in the plant are noted. Priority is given to remedying the deficiencies in the right order. The management rounds are scheduled in such a way that management visits every area at least twice a year.

Management training on safety culture
In 1999, Borssele management attended a special training programme on safety culture. Special attention was paid to safety culture aspects in performing root-cause event analyses. Work practices and safety culture can be important root causes of undesired events. To handle this aspect in a systematic way in the root-cause analysis, the HPES methodology developed by WANO has been introduced at Borssele.

Involvement of staff in peer reviews of international nuclear power plants
There is a tendency to drift into accepting small deficiencies in a plant. After a while, things are taken as normal. By involving the staff of the NPP in international peer reviews, it is possible to re-establish the 'normal standard'. On average, five employees of the Borssele NPP are involved in international peer reviews (INPO (HPES), OSART) every year.

Production of 'work practices' training films for contractors and NPP staff
The Borssele NPP has produced a one-hour training film showing examples of good and bad practice in normal working situations. All NPP staff and staff of most of the main contractors must watch it. Because the film is highly realistic and field workers recognise the situations shown in it, it is highly effective in improving work practices. The film is updated every year on the basis of the yearly event analysis. In 2001, showings of the film were preceded by a presentation by maintenance managers. This proved an effective way of communicating management expectations.

c. Evaluation of safety culture programme

In the years 2004-2006 it was concluded that the safety culture programme should have an extra effort. This was based on the increasing number of small incidents and reported incidents to the regulator, but also on the results of evaluations that came to the conclusion that root causes of incidents are mainly work practices, non-compliance with procedures and communication, and that this has been the case for years without improvement. At the same time the international organisations like WANO and IAEA warned about complacency. Several international documents were stressing the importance of safety management and safety culture. Also the KFD requested to look into the international

developments in its assessment report (2005) of the 10-yearly safety evaluation. In 2006, the Covenant was agreed, that allowed for 20 years extra for operation, if certain conditions are met. This offered a new horizon and perspective for the operating organisation and added to the importance of a safety culture program.

In reaction to this the Borssele NPP has started amongst others to introduce the following steps:

- Introduction in 2005 of the function ‘Safety culture officer’ who has the duty to establish and follow-up the overall safety culture and human performance plan;
- Using the WANO Performance Objectives and Criteria and the WANO good practises;
- Using WANO support and trainings to introduce for instance Operational Decision Making, Pre- and Post- job briefing;
- Increasing the frequency of WANO peer reviews;
- Company culture improvement plan 2007-2008;
- From 2008 onwards, a Human Performance & Safety Culture (HP&SC) improvement plan introducing INSAG-15 and WANO guidelines for Human Performance.

Important recent results in 2009-2010 are:

- Improvement plan from a WANO Peer review in 2008 (follow-up in 2010)
- Documented and visible Safety Policy Statement (policy level commitment)
- Management Expectations pocket booklets per main department (management commitment)
- Human Performance Techniques (individual commitment) using INPO 06-002, as translated in Dutch (training includes contractors)
- Management Expectations and HP&SC will become an element of the Quality Management System.

The Borssele NPP and the KFD evaluate each year what the results are of this new approach. The evaluation meetings also focus on developments regarding performance indicators and regular independent review of safety culture. Recently it has been decided to enlarge the scope of the annual meetings to include organisational developments. Further it has been decided that in the next OSART mission in September 2014 an additional Independent Safety Culture Assessment module will be used.

Appendix 4 REQUIREMENTS AND SAFETY GUIDES FOR THE BORSSELE NPP LICENCE

In the licence of the NPP, in licence condition II.B.7, Nuclear Safety Rules and Guidelines are referred, documented in NVRs. These are listed in the table.

No.	Title
NVR NS-R-3	'*Beoordeling van de vestigingsplaats voor kernenergiecentrales*' Adaptation of: IAEA Safety Requirements Safety Standard Series No. NS-R-3, Site Evaluation for Nuclear Installations Safety Requirements
NVR NS-G-3.1	'*Externe door de mens veroorzaakte gebeurtenissen bij de beoordeling van de vestigingsplaats voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-3.1, External Human Induced Events in Site Evaluation for NPPs
NVR NS-G-3.2	'*Verspreiding van radioactieve stoffen in lucht en water en beschouwing van de verdeling van de bevolking bij de beoordeling van de vestigingsplaats voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-3.2, Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for NPPs
NVR NS-G-3.3	*'Beoordeling van seismische gebeurtenissen van invloed op de veiligheid van kernenergiecentrales'* Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-3.3, Evaluation of Seismic Hazards for NPPs
NVR NS-G-3.4	*'Meteorologische gebeurtenissen bij de beoordeling van de vestigingsplaats voor kernenergiecentrales'* Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-3.4, Meteorological Events in Site Evaluation of NPPs
NVR NS-G-3.5	*'Beoordeling van overstromingsgevaar voor kernenergiecentrales met vestigingsplaats aan de kust of aan een rivier'* Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-3.5, Flood Hazard for NPPs on Coastal and River Sites
NVR NS-G-3.6	*'Geotechnische aspecten bij de beoordeling van de vestigingsplaats en funderingen voor kernenergiecentrales'* Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-3.5, Geotechnical Aspects of Site Evaluation and Foundations for NPPs
NVR NS-R-1	*'Veiligheid van kernenergiecentrales: veiligheidseisen voor het ontwerp'* Adaptation of: IAEA Safety Requirements Safety Standard Series No. NS-R-1, Safety of Nuclear Power Plants: Design Safety Requirements
NVR NS-G-1.1	*'Programmatuur voor computergestuurde veiligheidsrelevante systemen voor kernenergiecentrales'* Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.1, Software for Computer Based Systems Important to Safety in NPPs
NVR NS-G-1.2	*'Veiligheidsbeoordeling en -verificatie voor kernenergiecentrales'* Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.2, Safety Assessment and Verification for NPPs

No.	Title
NVR NS-G-1.3	'*Veiligheidsrelevante meet- en regelsystemen voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.3, Instrumentation and Control Systems Important to Safety in NPPs
NVR NS-G-1.4	'*Ontwerp van splijtstofhantering en -opslag systemen in kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.4, Design of Fuel Handling and Storage Systems in NPPs
NVR NS-G-1.5	'*Externe gebeurtenissen met uitzondering van aardbevingen in het ontwerp van kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.5, External Events Excluding Earthquakes in the Design of NPPs
NVR NS-G-1.6	'*Seismisch ontwerp en kwalificatie voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.6, Seismic Design and Qualification for NPPs
NVR NS-G-1.7	'*Bescherming tegen interne branden en explosies in het ontwerp van kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.7, Protection Against Internal Fires and Explosions in the Design of NPPs
NVR NS-G-1.8	'*Ontwerp van noodstroom systemen voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.8, Design of Emergency Power Systems for NPPs
NVR NS-G-1.9	'*Ontwerp van het reactor koel- en aanverwante systemen in kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.9, Design of the Reactor Coolant System and Associated Systems in NPPs
NVR NS-G-1.10	'*Ontwerp van reactor insluiting systemen voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.10, Design of Reactor Containment Systems for NPPs
NVR NS-G-1.11	'*Bescherming tegen interne gevaren anders dan branden en explosies in het ontwerp van kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.11, Protection Against Internal Hazards other than Fires and Explosions in the Design of NPPs
NVR NS-G-1.12	'*Ontwerp van de reactor kern voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.12, Design of the Reactor Core for NPPs
NVR NS-G-1.13	'*Stralingsbescherming aspecten in het ontwerp voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.13, Radiation Protection Aspects of Design for NPPs
NVR NS-R-2	'*Veiligheid van kernenergiecentrales: veiligheidseisen voor de bedrijfsvoering*' Adaptation of: IAEA Safety Requirements Safety Standard Series No. NS-R-2, Safety of Nuclear Power Plants: Operation Safety Requirements
NVR NS-G-2.1	'*Brandveiligheid in de bedrijfsvoering van kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.1, Fire Safety in the operation of NPPs
NVR NS-G-2.2	'*Bedrijfslimieten en –voorwaarden en bedrijfsvoeringsprocedures voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.2, Operational Limits and Conditions and Operating Procedures for NPPs

No.	Title
NVR NS-G-2.3	'*Wijzigingen aan kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.3, Modifications to NPPs
NVR NS-G-2.4	'*De bedrijfsvoeringsorganisatie voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.4, The Operating Organization for NPPs
NVR NS-G-2.5	'*Beheer van de kern en splijtstof hantering voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.5, Core Management and Fuel Handling for NPPs
NVR NS-G-2.6	'*Onderhoud, toezicht en in-service inspecties in kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.6, Maintenance, Surveillance and In-service Inspection in NPPs
NVR NS-G-2.7	'*Straling bescherming en radioactief afval tijdens het bedrijven van kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.7, Radiation Protection and Radioactive Waste Management in the Operation of NPPs
NVR NS-G-2.8	'*Werving, kwalificatie en training van personeel voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.8, Recruitment, Qualification and Training of Personnel for NPPs
NVR NS-G-2.9	'*Inbedrijfstelling voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.9, Commissioning for NPPs
NVR NS-G-2.10	'*Periodieke veiligheidsbeoordeling voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.10, Periodic Safety Review of NPPs
NVR NS-G-2.11	'*Een systeem voor de terugkoppeling van ervaringen van gebeurtenissen in nucleaire installaties*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.11, A System for the Feedback of Experience from Events in Nuclear Installations
NVR NS-G-2.12	'*Verouderingsbeheer voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.12, Ageing Management for NPPs
NVR NS-G-2.13	'*Beoordeling van seismische veiligheid voor bestaande nucleaire installaties*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.13, Evaluation of Seismic Safety for Existing Nuclear Installations
NVR NS-G-2.14	'*Bedrijfsvoering van kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.14, Conduct of operations at NPPs
NVR NS-G-2.15	'*Beheer van zware ongevallen voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.15, Severe Accident Management Programmes for NPPs
NVR GS-R-3	'*Het managementsysteem voor faciliteiten en activiteiten*' Adaptation of: IAEA Safety Requirements Safety Standard Series No. GS-R-3, The Management System for Facilities and Activities
NVR GS-G-3.1	'*Toepassing van het managementsysteem voor faciliteiten en activiteiten*' Adaptation of: IAEA Safety Guide Safety Standard Series No. GS-G-3.1, Application of the Management System for Facilities and Activities

No.	Title
NVR GS-G-3.5	'*Het managementsysteem van nucleaire installaties*' Adaptation of: IAEA Safety Guide Safety Standard Series No. GS-G-3.5, The Management System of Nuclear Installations
NVR GS-R-4	'*Veiligheidsbeoordeling voor faciliteiten en activiteiten*' Adaptation of: IAEA Safety Requirements Safety Standard Series No. GS-R-4, Safety Assessment for Facilities and Activities
NVR GS-G-4.1	'*Vorm en inhoud van het veiligheidsrapport voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. GS-G-4.1, Format and Content of the Safety Analysis Report for NPPs
NVR SSG-9	'*Seismische gevaren bij de beoordeling van de vestigingsplaats voor nucleaire installaties*' Adaptation of: IAEA Safety Guide Safety Standard Series No. SSG-9, Seismic Hazards in Site Evaluation for Nuclear Installations
NVR SSG-2	'*Deterministische veiligheidsanalyse voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. SSG-2, Deterministic Safety Analysis for NPPs
NVR SSG-3	'*Ontwikkeling en toepassing van niveau 1 probabilistische veiligheidsanalyse voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. SSG-3, Development and Application of Level 1 Probabilistic Safety Assessment for NPPs
NVR SSG-4	'*Ontwikkeling en toepassing van niveau 2 probabilistische veiligheidsanalyse voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. SSG-4, Development and Application of Level 2 Probabilistic Safety Assessment for NPPs
NVR GS-R-2	'*Gereedheid voor en bestrijding van een nucleaire of radiologische noodsituatie*' Adaptation of: IAEA Safety Requirements Safety Standard Series No. GS-R-2, Preparedness and Response for a Nuclear or Radiological Emergency
NVR GS-G-2.1	'*Voorbereiding voor de gereedheid voor en bestrijding van een nucleaire of radiologische noodsituatie*' Adaptation of: IAEA Safety Guide Safety Standard Series No. GS-G-2.1, Arrangement for Preparedness and Response for a Nuclear or Radiological Emergency
NVR 2.1.1	'*Safety functions and component classification for BWR, PWR and PTR*' Adaptation of: IAEA Safety Guide Series No. 50 SG-D1
NVR 3.2.1	Voorschriften Opleiding van Bedieningspersoneel van Kernenergiecentrales

Appendix 5 TECHNICAL DETAILS OF BORSSELE NPP

a. Technical specifications

The Borssele nuclear power plant is a light water PWR with a thermal power of 1366 MW and a net electrical output of approximately 490 MW. The installation is a two-loop plant designed by Siemens/KWU. The plant has been in operation since 1973. The reactor and the primary system, including steam generators, are in a spherical steel containment. This steel containment is enveloped by a secondary concrete enclosure.

The Borssele NPP characteristics can be found in the following publications:

- the Netherlands' National Report on the post – Fukushima Daiichi stress test for the Borssele NPP, published in December 2011
  (link: http://www.rijksoverheid.nl/bestanden/documenten-en-publicaties/rapporten/2011/12/20/nationaal-rapport-over-de-stresstest-van-de-kerncentrale-borssele/netherlands-national-report-on-the-post-fukushima-stress-test.pdf)
- The report by LH EPZ on the Complementary Safety margin Assessment (CSA, a.k.a 'stress test'), published October 31 2011
  (link: http://www.kerncentrale.nl/resultatenrobuustheidsonderzoek/EN/)

The end of this Annex shows graphs of the overall plant availability over the years, the number of incident reports from 1990 onwards and the number of unwanted automatic scrams over the years.

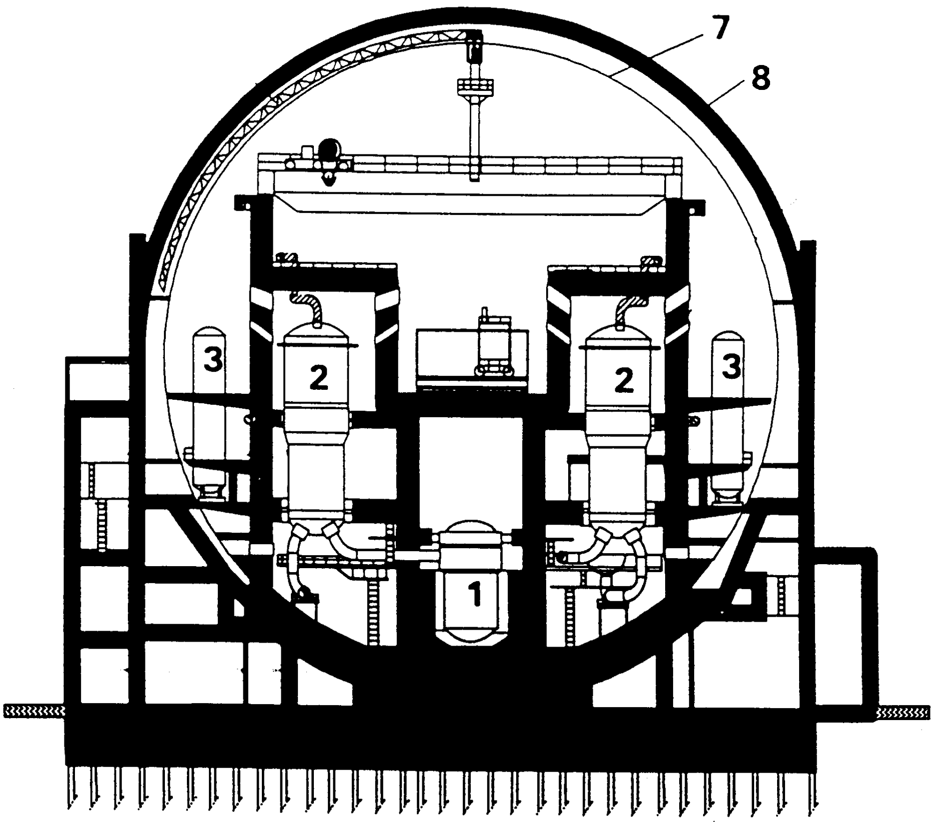


Figure 3 Cross-section of reactor building of Borssele NPP

1. Reactor pressure vessel
2. Steam generator
3. Medium-pressure core inundation buffer tank
7. Steel containment
8. Secondary concrete enclosure (shield building)

b. Safety improvements from the first 10-yearly Periodic Safety Review

In the late 1980s, mainly as a result of the Chernobyl accident, the Dutch government formulated an accident management and back-fitting policy. Both utilities (Borssele and Dodewaard) were asked to upgrade the safety of their plants by incorporating state-of-the-art features. With the aid of the respective reactor suppliers, the two utilities developed a new safety concept for their plants in the early 1990s. The utility operating the Borssele NPP (which was 20 years old at the time) embarked on a € 200 million modification programme, while Dodewaard was closed because of economic reasons.

The new safety concept was largely based on a comparison of the plant's current design basis with national and international deterministic nuclear safety rules; deterministic studies of the plant; insights gained from similar designs; operating experience and, last but not least, insights derived from the German Risk Study (DRS-B). A plant-specific PSA was performed in parallel with the activities for the conceptual design. This PSA played a major role in later stages of the modification programme. Once the safety concept had been finalised, it was translated into a 'safety plan', consisting of a package of modification proposals for the plant systems, structures and components. In the previous CNS-5 report an extensive list of important modifications can be found.

The main goals of the safety improvements were:

- Extensive improvement of functional and physical separation of redundant systems and increase of redundancies and some diverse systems;
- Improvement of protection against external events (e.g. reserve residual heat removal by well pumps, emergency control room in hardened building, emergency response center in bunker);
- Improve protection against LOCA, SB-LOCA, MSLB, SGTR and SBO;
- Improve AM and SAM (introduction of SAMG's, PAR's and filtered venting, bleed and feed);
- Modernisation of control room and full scope simulator.

c. Modifications due to the second 10-yearly Periodic Safety Review

The Borssele NPP in 2003 finalised its second 10-yearly periodic safety review. The safety-interests of the improvement-issues have been estimated, from a nuclear safety point of view as well as from a radiation protection point of view using both deterministic and probabilistic considerations.

The probabilistic safety interest of an improvement issue is based upon the maximum possible decrease of the core damage frequency (TCDF PSA level 1) and the decrease of the individual risk (IR PSA level 3). For each echelon of the defence in depth concept modifications have been suggested. In the period 2005-2007, the majority of the modifications has been implemented.

The main goal in the technical area was to further strengthen the safety concept that was introduced in the 1st PSR. On the other hand to put increased efforts in the area of safety analysis, ageing aspect, the organisation and emergency procedures. A list of improvements has been presented in the CNS-5 report. Some items still relevant today e.g. in relation to post-Fukushima Daiichi evaluations are:

Technical measures:
- Increasing the supply of diesel oil in the bunker systems from 24 hours to 72 hours;
- Installation of a second reserve cooling water (TE) pump;
- Automatic starting of the bunkered primary reserve injection system if the level in the RPV becomes too low during midloop operation;

Organisational, personal and administrative measures:
- Improvement of the emergency Operating Procedures (EOPs) with regard to avoiding dilution of the primary coolant after start-up of a main coolant pump;

- Implementation of Severe Accident Management Guidelines for low-power and shut-down modes of operation;
- Implementation of an E-0 optimal recovery guideline for low-power and shut-down modes of operation (E-0 = reactor trip and safety injection, diagnostics).

d. Man-machine interface (MMI) and emergency procedures

MMI was an important topic in the Borssele back-fitting programme that was implemented in 1997. It encompassed:

- enlargement and complete retrofit of the main control room,
- addition of a secondary (emergency) control room in a new external events hardened building,
- a full-scope replica simulator, including main and secondary control room,
- an emergency response and communication facility in the cellar under the office building.

With the introduction of the Westinghouse procedures in the middle of the nineties also the Critical Safety Funtions monitor was introduced in the control room.

At the Borssele NPP, an integrated Event-Based and Symptom-Based package of Emergency Operating Procedures (EOPs) is used:

- The Optimal Recovery Guidelines (ORGs); ‘Event’-based procedures for LOCA, Secondary Line Break, SGTR and combinations of these.
- The Function Restoration Guidelines (FRGs); ‘Symptom’-based procedures for the overall safety of the plant.

In the CNS-5 report for the fifth review meeting more details about the design of the MMI and the control room can be found in its Annex on the Technical Details of Borssele NPP.

e. Third PSR

The evaluation report on the 3rd PSR will be finished by the end of 2013. The prosed improvement measures are not yet known today. A number of actions from the stresstest have been merged with the 3rd PSR. During the CNS’s sixth review meeting, the mains results of the 3rd PSR will be presented.

One issue will need special attention from the Regulatory Body (RB): digital I&C.

The allowance for long-term operation until 2034 may make it unavoidable to replace the still analog instrumentation and control systems of the NPP Borssele with digital systems. These replacements will be carried out in a step by step approach in the coming years.

f. Data on radiation protection and exposure

There has been a downward trend in the average effective individual dose at the Borssele plant ever since 1983. This is true both of plant personnel and of externally hired personnel. In the early eighties, the average effective individual dose was 4 mSv per annum for Borssele personnel and 5 mSv per annum for externally hired personnel. By the end of the nineties, the figures had decreased to 1 mSv and 1.5 mSv respectively. The trend of low doses seems to continue past the millennium.

The trend in the collective dose has been very similar to that in the individual doses. The total collective dose amounted to 4 manSv per annum in the early eighties. By the end of the nineties it had decreased to 1.0 manSv per annum. The trend of low doses seems to continue past the millennium.

Apart from the regular activities, the modification activities carried out in 1997 resulted in an additional collective dose of 1.8 manSv. The highest individual dose received in 1997 was 14.0 mSv.

The legal dose limits for members of the public are as follows:
- dose limit for any one source is 0.1 mSv per annum;
- dose limit for all sources together is 1 mSv per annum.

See Appendix 1 for the background to and justification of these figures.

The discharge limits in the licence for the Borssele NPP are as follows:

Allowed releases in air per annum:

Noble gases	500	TBq
Halogens	50	GBq, …of which a maximum of 5 GBq J-131
Aerosols	500	MBq
Tritium	2	TBq
Carbon-14	300	GBq

Allowed releases in water per annum:

Alpha emitters	200	MBq
Beta/gamma emitters (excl. 3H)	200	GBq
Tritium	30	TBq

The dose consequences to members of the public due to releases in amounts equal to the aforementioned limits are estimated to be:
- maximal individual dose from releases in air: about 0.7 microSv per annum;
- maximal individual dose from releases in water: about 0.01 microSv per annum.

Actual releases from 1973 onwards are shown on the following pages. As the actual releases are normally less than 5% of these discharge limits, the actual doses are also less than 5% of the aforementioned maximum doses.

The (actual) collective dose to the public from the releases in air is estimated at $1 * 10^{-3}$ manSv per annum.

The (actual) collective dose to the public from the releases in water is estimated at $5.3 * 10^{-6}$ manSv per annum.

g. Discharges, doses and other relevant diagrams for Borssele NPP

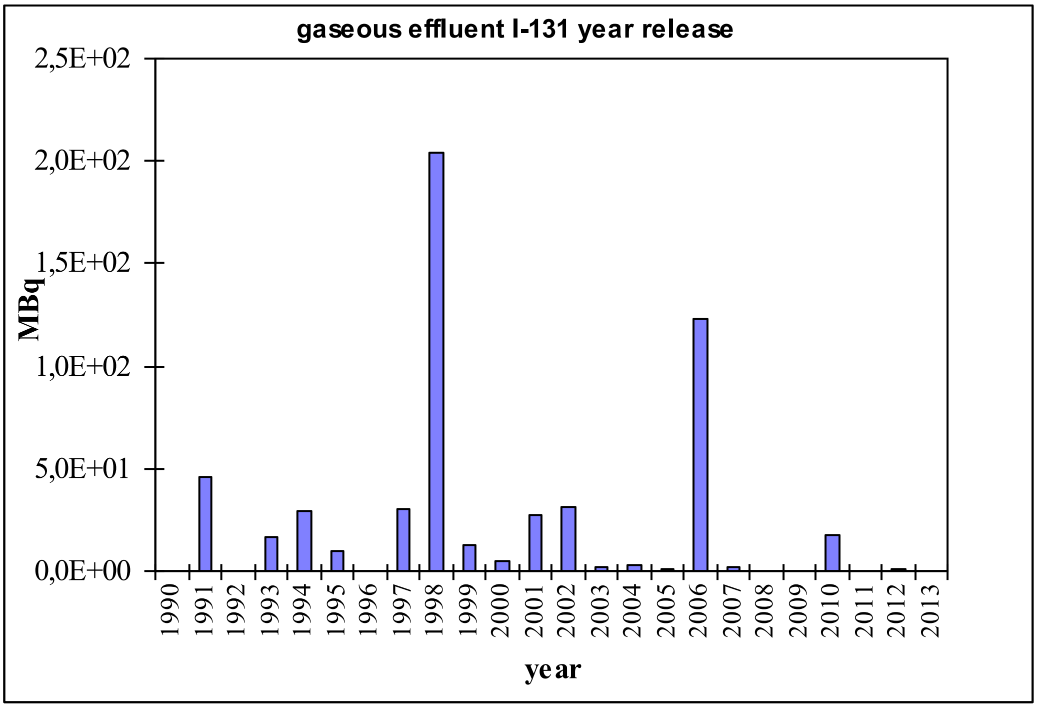


Figure 4 Borssele NPP discharges in air of I-131. Licence limit is 5000 Mq/year.

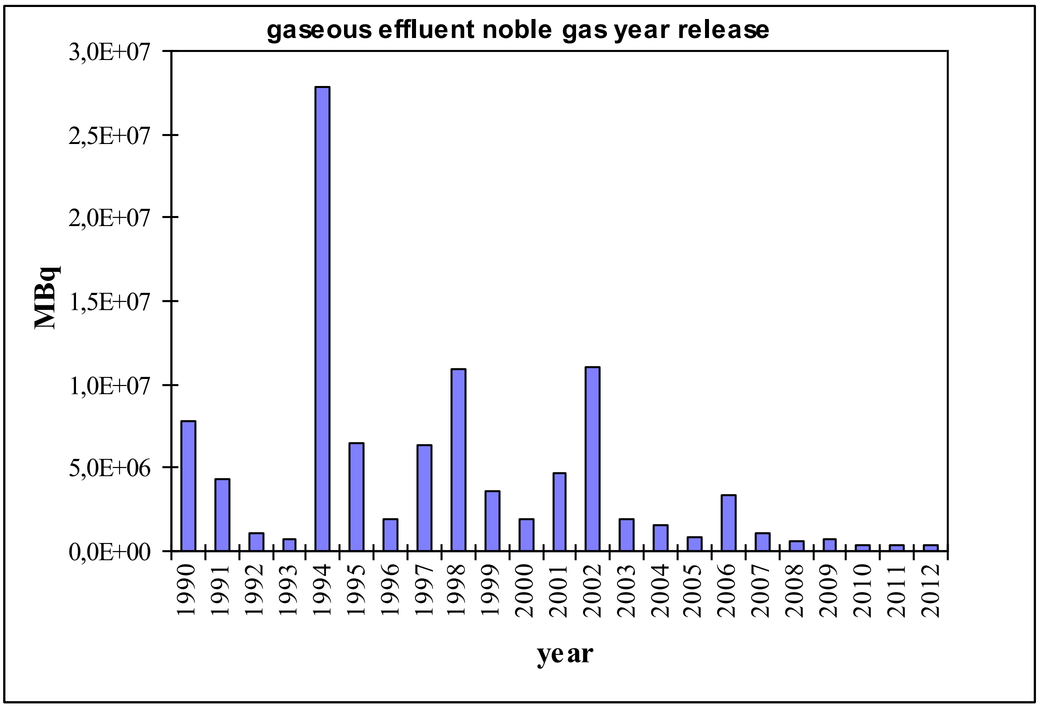


Figure 5 Borssele NNP discharges in air of noble gases. Licence limit is 500 TBq/year.

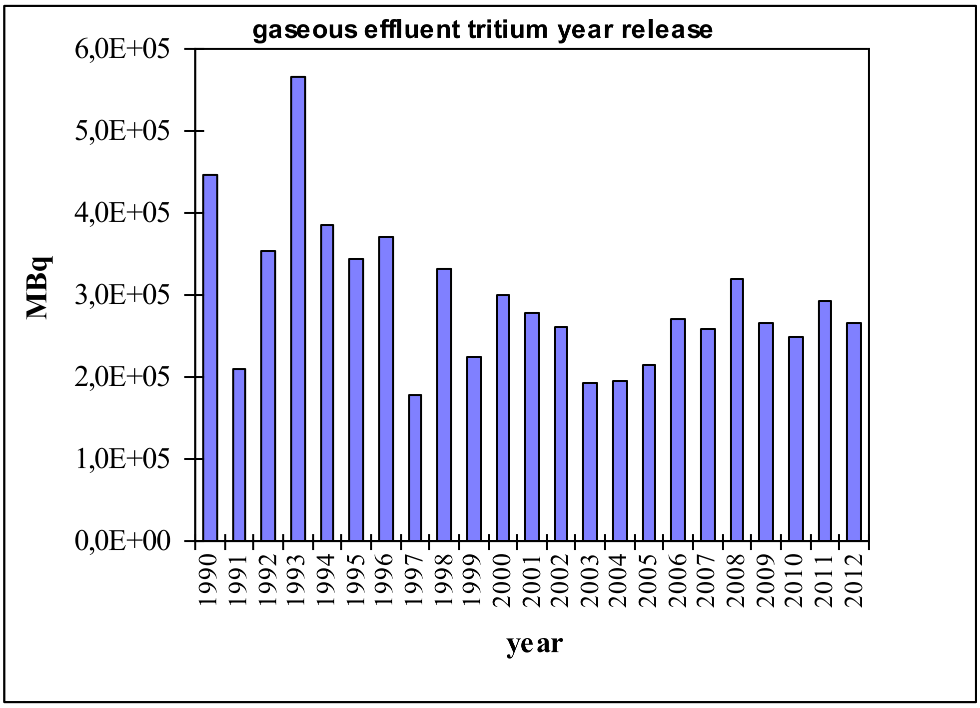


Figure 6 **Borssele NPP discharges in air of tritium, licence limit 2 TBq/year.**

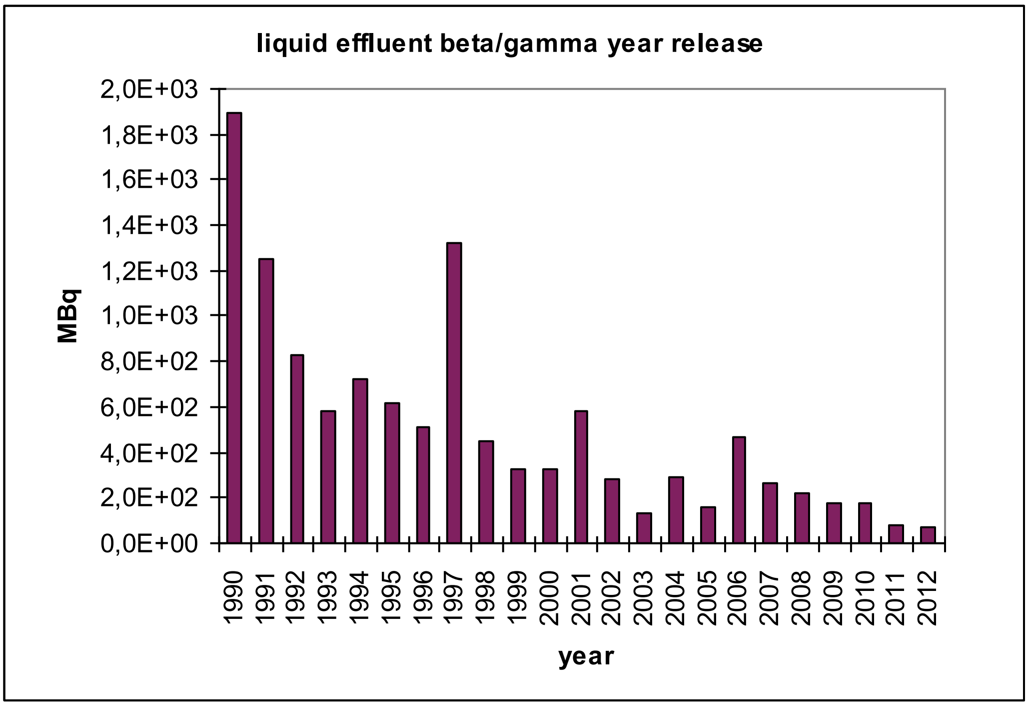


Figure 7 **Borssele NPP discharges in water of beta/gamma emitters. Licence limit 200 Gbq/year.**

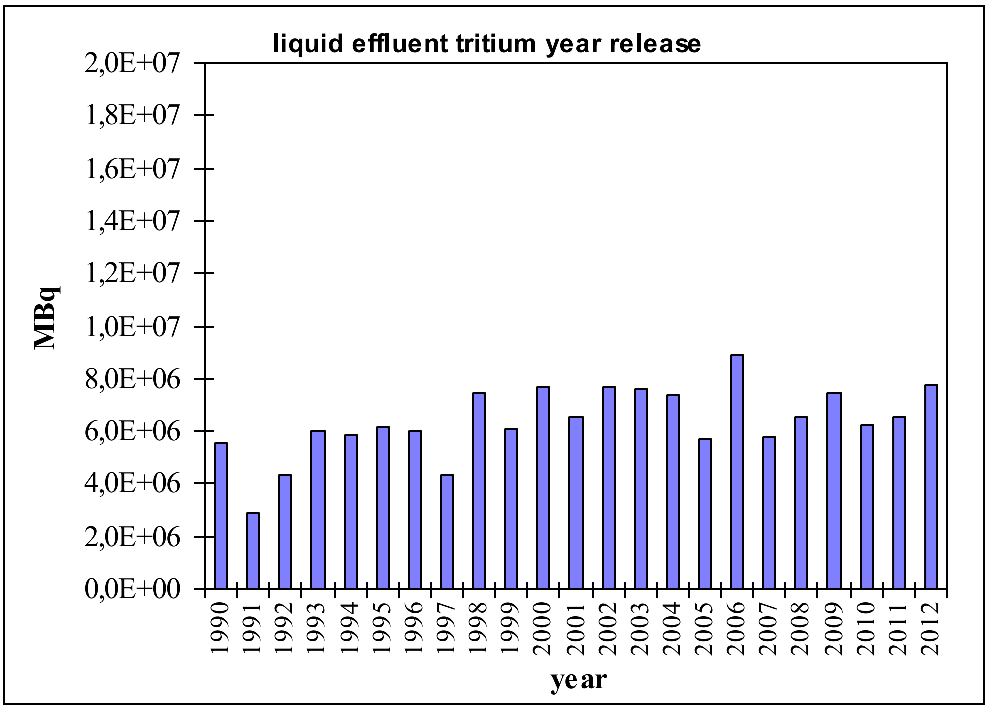


Figure 8 **Borssele NPP discharges in water of tritium, licence limit 30 TBq/year**

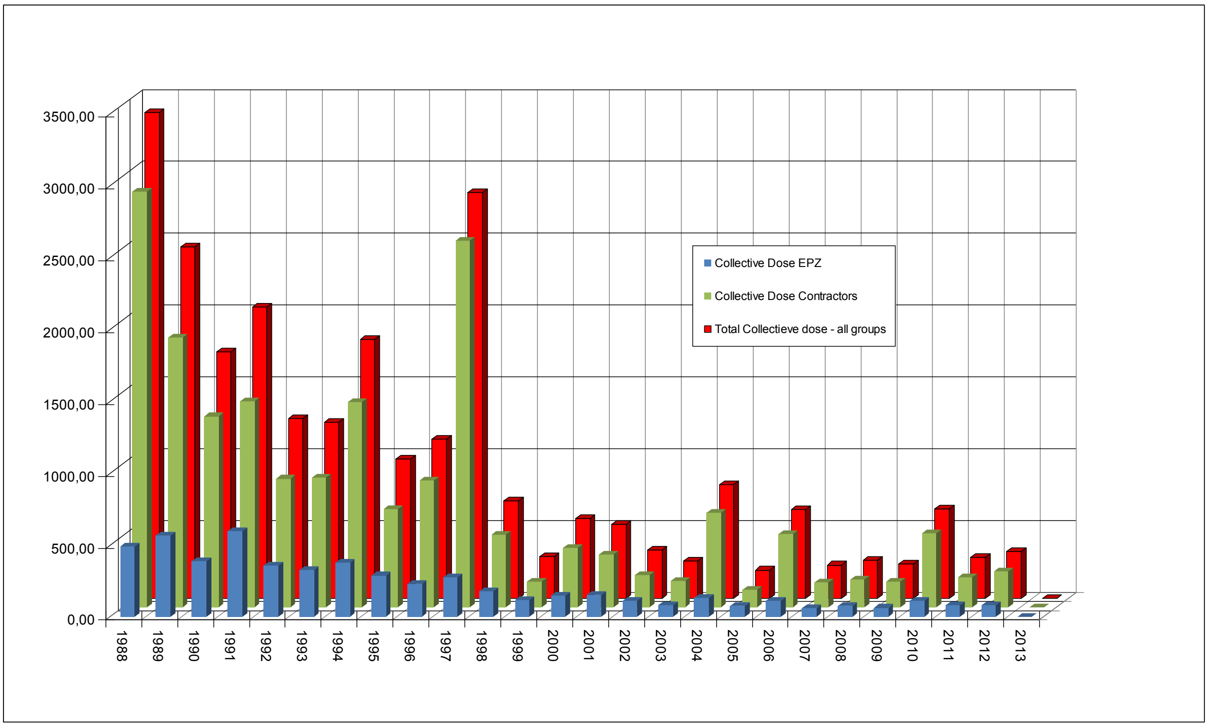


Figure 9 **Borssele NPP annual collective occupational dose**

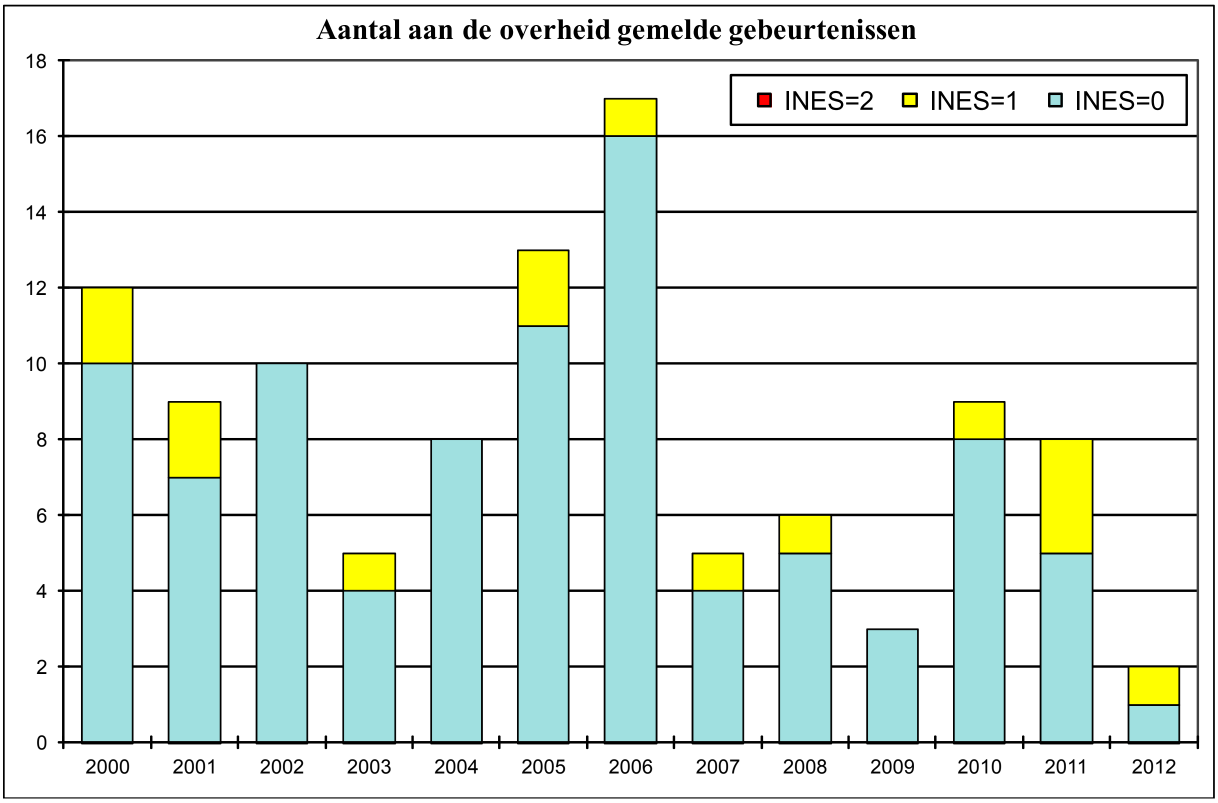


Figure 10 **Number of incident reports**

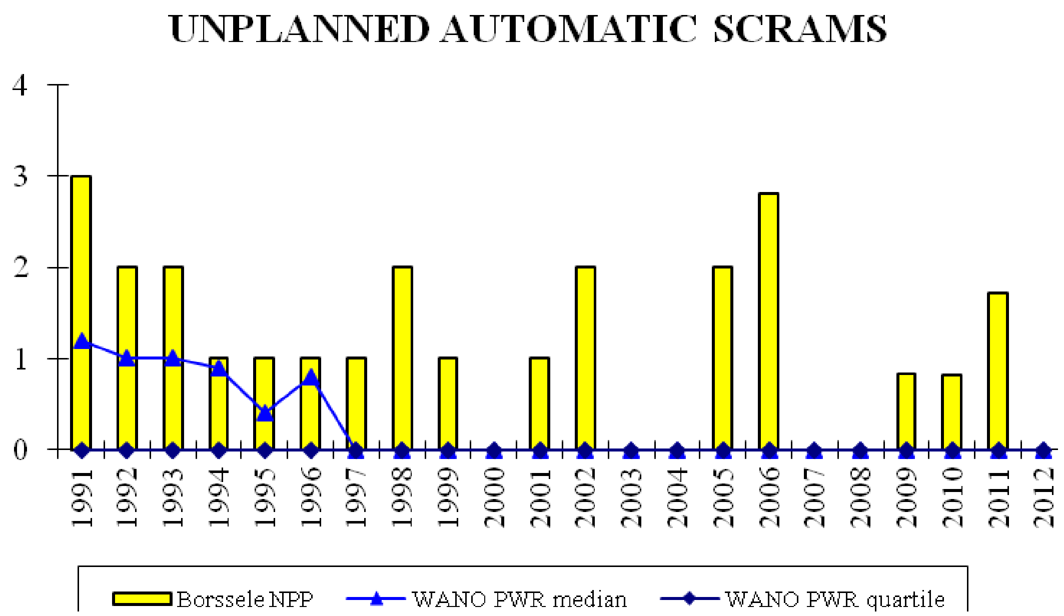


Figure 11 **Unplanned automatic scrams.**

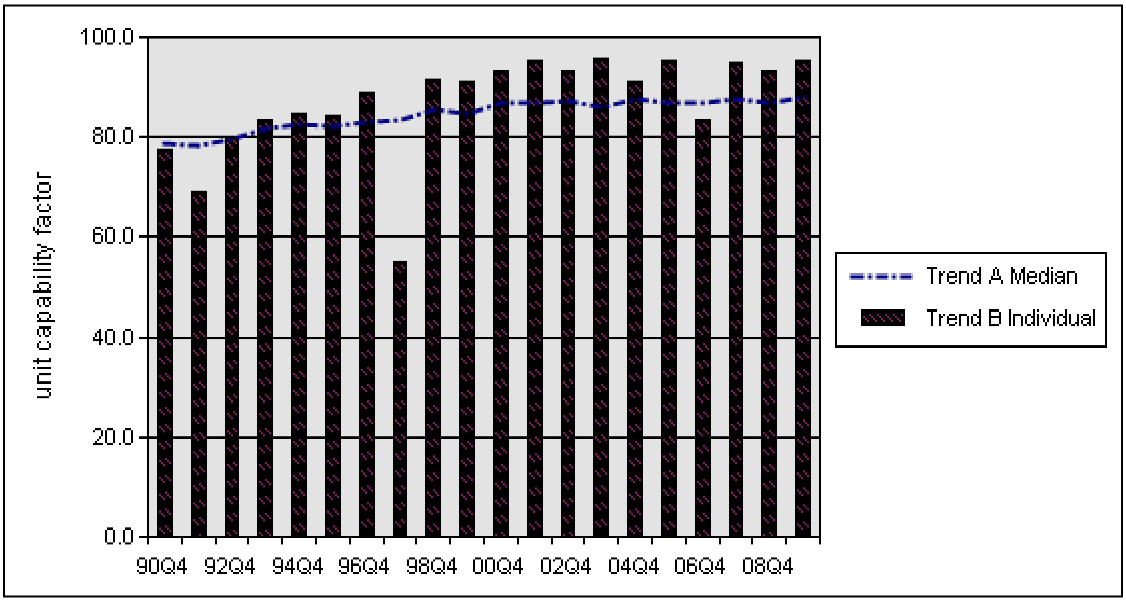


Figure 12 Unit capability factor.

Trend A Median is the world-wide trend, based on the WANO database, Trend B is the trend of the Borssele NPP.

Appendix 6 BORSSELE NPP COVENANT

Introduction Covenant

The operation licence for the Borssele nuclear power plant was issued in 1973 and does not contain a predetermined expiration date. This means that as long as the requirements (as stated in the regulations and the licence) are fulfilled, the plant is allowed to operate. The Regulatory Body (RB) is charged with the monitoring and control of the requirements and will intervene if necessary.

Following political pressure to shut down the plant (first by the end of 2003, later by the end of 2013) and in consideration of the new tasks and responsibilities of the government in the, now liberalized, energy production market, the desirability of a clearly predefined expiration date for the licence was recognized by the government. However, a unilateral decision of the RB to shut down the plant on a short notice, even if technically possible, might lead to a considerable claim. Also it was recognized that technical possibilities exist for continuing to operate the Borssele NPP safely after 2013 and that continued operation after 2013 could help to reduce greenhouse gas emissions.

An agreement with the owners of the Borssele NPP (EPZ) and its shareholders Essent and Delta was therefore pursued, by which several issues could be settled and from which both the government and the plant owners could benefit. This resulted in the ‘Borssele Nuclear Power Plant Covenant’ which was signed in June 2006 by the Dutch government and the owners of the plant. In the covenant they agreed upon extending the operating life of the plant to no later than December 31st 2033 and the additional conditions which should be met during the remaining operating life. The agreements in the covenant are in addition to the requirements of the operation licence, which remains in full force.

The main agreements in the Covenant, besides the closing date, regard: 1) a so-called ‘safety-benchmark’; 2) extra incentive for more sustainable energy management in relation to the closing date of the Borssele plant; 3) funding of decommissioning costs. The translation of the complete Covenant can be found in the CNS-5 report of the Netherlands[58].

The so-called ‘safety-banchmark’ agreement relates to the safety of the Borssele power plant. It requires that the Borssele NPP keeps belonging to the top-25% in safety of the fleet of water-cooled and water-moderated reactors in the European Union, Canada and the USA. To assess whether Borssele NPP meets this requirement, the Borssele Benchmark Committee (BBC) has been established.

Borssele Benchmark Committee

At the end of 2008 the Borssele Benchmark committee was established by the parties of the ‘Borssele Nuclear Power Plant Covenant’. In accordance with the Covenant, two members of this committee were appointed by the central government, two more were appointed by the owners of the plant. All Covenant parties jointly appointed the chairman of the committee.

Methodology

The committee should determine if the NPP is among the twenty-five percent safest water-cooled and water-moderated power reactors in the European Union, the US and Canada. This implies ranking the safety of about 250 power stations and establishing whether Borssele is among the safest 25%. The safety analysis should cover the design, operation, maintenance, ageing and safety management. The committee developed a methodology for assessing the safety performance of the NPP Borssele as required by the Covenant.

[58] published September 2010 for the fifth review meeting in April 2011.

The committee feels confident that with smart use of the available data combined with expert qualitative assessment it will be possible to conclude with sufficient confidence if KCB is among the safest 25% of power stations or not.

To do so it decided to make a separate safety evaluation of the reactor design and the way reactors are operated. The latter assessment will cover operation, maintenance, ageing and safety management. Considering its task the committee focuses only on safety aspects that are relevant for the surrounding environment of the plant. Risks that may lead to damage of the plant and/or personnel operating the plant but provide no hazard outside the plant are not taken into account. The economic impact of these risks can be considerable but are solely born by the plant owner.

Planning
The first report of the committee will be available in September 2013.

Appendix 7 HIGH FLUX REACTOR (HFR)

a. General description

The HFR is a relatively large research reactor with a current thermal output of 45 MW_{th}. It is a tank in pool type reactor of a design similar to the old Oak Ridge Reactor in the USA. Comparable reactors are the R2 reactor in Studsvik, Sweden and the Safari reactor in Palindaba, South Africa. The latter is still in operation.

The aluminium reactor vessel with 4.5 cm thick walls (core box) is located at the bottom of a 9 m deep pool (Figure 13). It operates at a low primary pressure of several bars. In 1984 the first reactor vessel was replaced by the current vessel, partly because radiation induced embrittlement of the core box was suspected. Later, it turned out that this embrittlement was far less than anticipated. The reactor vessel and the reactor pool are located inside a gas-tight steel containment with a 25 m diameter and 12 mm thick walls. A closed primary cooling circuit is connected to the reactor vessel. This primary circuit consists of 16” and 24” aluminium piping, a 43 m^3 decay tank, three electrically driven main primary cooling pumps and three heat exchangers.. The heat is discharged by an open secondary system, pumping water from a canal to the sea. The decay tank, primary pumps and heat exchangers are located in a separate pump building, together with two electrically driven decay heat removal pumps. In addition, decay heat can also be discharged by natural circulation over core and pool.

The HFR was originally designed to operate with over 89% high enriched U.Alx as fuel. In 2005 a new licence was issued to operate the reactor in future using low enriched uranium (LEU) with an enrichment of less than 20%. The conversion from HEU to LEU was completed in the autumn of 2006. Technical details can be found in the CNS-5 report published in September 2010 for the fifth review meeting of the CNS in April 2011.

b. History and use of HFR

The construction of the facility began in the mid-fifties at the Petten site, a location in the dunes close to the sea. The reactor core achieved criticality for the first time in 1961. In 1962, following a special request by the Dutch government, an agreement between the Dutch government and the European Community for Atomic Energy (Euratom) was signed by which it was decided that Petten would host one of the four Joint Research Centres (JRC). As a consequence of that agreement, ownership of the reactor was transferred to the European Committee for Atomic Energy (Euratom) in 1962.

Although the Joint Research Centre (JRC) Petten became the LH, the operation and maintenance of the reactor was subcontracted to the founding organisation, Reactor Centre Netherlands. This organisation was later renamed the Energy Research Foundation Netherlands (ECN). In 1998, the nuclear branches of ECN and KEMA (a research institute of the Electric Power Utilities) were merged and the operation of the HFR was consequently transferred to the newly formed organisation NRG (Nuclear Research and consultancy Group). NRG was also granted the right to exploit the HFR commercially.

In 2002 the HFR was temporary shutdown for more than a month for safety concerns, being indications of growing weld indications and safety culture deficiencies. After independent investigations by two different organisations, one of which was an INSARR mission in 2002 by the IAEA, the reactor was allowed to restart after the realisation of several immediate actions and the adoption of an improvement plan to be carried out in the next years. One of the advices of IAEA was the transfer of the licence from the JRC to the operator NRG, which was realised in 2005. Although much of the use of the reactor is still in the field of materials research, including new fuel types, the reactor is increasingly being used for medical applications i.e. radioisotopes for diagnostic purposes and patient treatments.

c. Modifications

From 2002 to 2005 a first periodic safety review (PSR) was executed. References were the existing IAEA rules and regulations for research reactors, complemented with some principles applied in nuclear power reactors. The design basis got newly defined by a complete set of PIE analyses. Ageing and operating experience were investigated and there was a survey of the state of the art, which included visits to other research reactors. A probabilistic risk scoping study complemented the deterministic analyses. The safety review resulted into a list of recommendations and suggestions. This led to a Safety Design and Modification Concept. The most important modifications were described in the aforementioned nuclear licence of 2005.

The new safety concept of the HFR is mainly based on three safety functions: safe shut-down of the reactor, long-term decay-heat removal, and containment. This concept is based on the traditional principles of defence-in-depth and multiple safety barriers for all accident conditions. In addition, a 30-minute autarchy period has been introduced during which no credit for operator intervention is taken. The safety analyses and risk scoping study being conducted within the framework of the 10-yearly periodic safety review, bearing in mind this safety concept, have produced a number of recommendations for improvements, most of which are implemented in the last two years as part of a major modification programme. Due to media and political attention, a measure to overcome the effects of a special large-break LOCA (installation of a vacuum breaker on the reactor vessel head) has been licensed separately and was implemented in late 2003. The major features of the modification programme implemented are:

- installation of additional vacuum breakers on the primary system to prevent uncovering of the core during a large break LOCA;
- installation of Accident Pressure Equalisation lines preventing pressure built up and uncovering of the core in the event of a boiling core;
- controlled use of pool water in case of a primary leak combined with loss of power by installation of pool water injection valves; this enhances the passive safety of the plant;
- replacement of one diesel driven decay heat removal pump by an electrical pump with own battery back-up, increasing the availability of the emergency core cooling;
- modification of Emergency Power System logic;
- limitation of the portal crane movement inhibiting hoisting above the reactor vessel during reactor operation;
- a shock damping structure to prevent pool damage by a falling transport container;
- installation of a manual operated alternative shutdown system for ATWS events;
- jackets around existing siphons in the primary cooling water system providing redundant containment isolation.

The last topic has been replaced with a semi break preclusion concept with leak detection, because the original modification turned out not to be feasible.There is still one issue open: the shock damping structure.

The second PSR, which started in 2011 is still going on.

d. Licence renewal

In 2005, with a further addition in 2007, the licence of the HFR was renewed for several reasons.

- The licence existing at that time was obsolete. It was issued before the Nuclear Energy Act entered into force and revisions so far had been fragmentary;
- Due to the first 10-yearly Periodic Safety Review the HFR needed a significant upgrade. A new updated Reference Licensing Basis and a new Safety Analysis Report (SAR) were issued in the process. In order to make the safety upgrade possible, a new licence was needed;

- The HEU-LEU conversion also required a licensing procedure;
- The transfer of the licence from JRC to NRG required a new licence as well.

New licence conditions were issued by the Regulatory Body (RB), among others:
- The 10-yearly Periodic Safety Review are mandatory;
- Every 5 years an IAEA-INSARR mission or alike should be held;
- The allowed amount of spent fuel in the fuel storage pool, after a transition period of 3 years, is limited to 500 fuel elements. Spent fuel should be shipped as soon as possible to the waste storage facility COVRA;
- Organisational changes or changes in the mandate of the senior-managers need prior approval of the director of the KFD;
- The reference licensing basis as developed for the 10-yearly Periodic Safety Review is part of the mandatory regulation for the HFR;
- An ageing management system has to be maintained (after having been developed);
- A system for operational feedback is institutionalised.

e. IAEA-INSARR missions

In 2002 an IAEA-INSARR mission was conducted with emphasis on safety culture. Refer to the CNS-3 Dutch national report on the Convention on Nuclear Safety for a more detailed description of the safety culture issues at that time.

Prompted by the earlier identified safety culture issues as well as the recommendations of the IAEA-INSARR-mission, the inspectorate of the RB (the KFD) formulated a licence condition for the new licence, which required every 5 years an IAEA-INSARR review or equivalent independent audit to be conducted. This requirement resulted into transformation of the follow-up mission of the 2002 INSARR into a full scope new mission. This second INSARR-mission was held in 2005 and at that time it was the mission with the largest scope and the largest number of experts (10) in the team. It was noted that almost all issues identified in the 2002 INSARR mission were resolved. Special mention was made in the report on the implementation of the Safety Culture Enhancement Plan, that succeeded to resolve most of the pending safety issues and followed the recommendations and suggestions provided by the INSARR mission of 2002.

In 2008 KFD carried out its own safety culture audit, followed up in 2012. The conclusion was that not in all areas improvements were visible and that some old weaknesses were still unsolved. The LH will continue working on safety culture improvement and both RB and LH have agreed to have in the future annual meetings about plans and progress.

f. Tritium leakeage to the environment

Based on a recommendation from a IAEA mission in 2010, five groundwater measurements points (wells) were installed at the site around the HFR. In one of these, a level of 50 Bq/l was detected in 2010 and this disappeared without a clue about the reason. In 2011 again a low level of tritium was detected, but in april 2012 a higher level of 230 Bq/l was detected. More and deeper monitors (up to 200) were installed to find the cause. Levels up to 175kBq/l then were detected in oktober 2012. In November 2012 the origin of the sources was found.

It was discovered that underground aluminium-piping between different buildings were degraded. The affected pipeline is part of a system that is only used during maintenance periods when water from the reactor basin is pumped temporarily into a storage tank[59].

[59] During the repair of the damaged pipeline, an alternative pipeline available for use during maintenance shutdowns, served as a temporary replacement.

The area of groundwater contamination was determined to have a length of 125 m and a width of 25 m and a maximum depth of 10 m. Since January 2013 the complete remediation of the area is is ongoing. There is no impact on the public health.

g. Primary system leakage and repair

In December 2012 a leakage was detected between the primary system and the fuel pool (seal leakage from the bottom plug). Since then the reactor was kept out of operation to find the cause and a solution of the problem. Because a simple repair was not possible, a modification, in fact extension of the primary system was proposed by the LH. The RB agreed on this modification, and after its implementation, the reactor started up in June 2013.

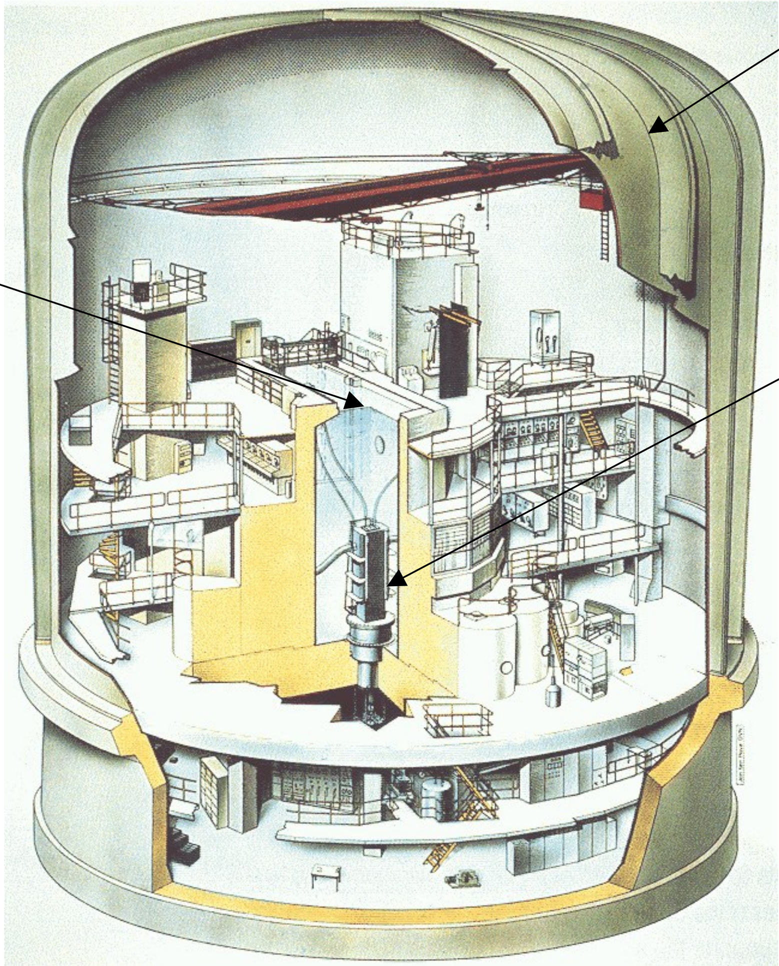


Figure 13 3D Cross section of reactor building of the HFR

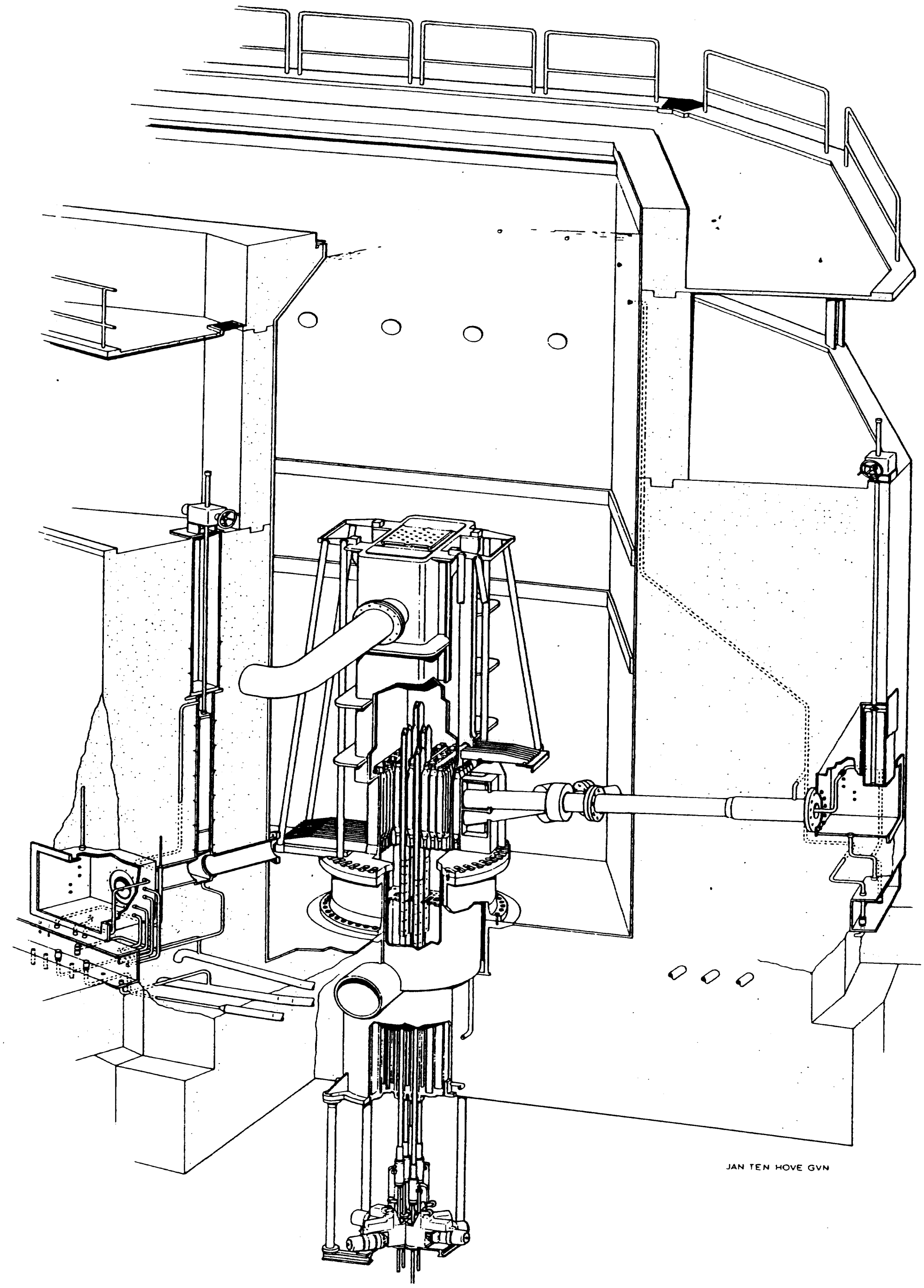


Figure 14 Reactor vessel in reactor pool of the HFR

Appendix 8 Missions visiting Borssele NPP

This appendix gives some information on the findings of two missions to the Borssele NPP.: the IPSART and the SALTO mission. It should be noted that final results from SALTO will only become available after the follow up mission planned for February 2014.

a. SALTO 2012 Recommendations and Suggestions

With respect to SALTO, only the most important recommendation are listed in this Appendix.

- It is recommended that the plant should apply a more effective approach to improve human performance in a tangible manner.
- The team recommends to the plant that a documentation of the EPZ positions, in respect of the NVR-rules applicable to Long Term Operation and Ageing Management, are created. These documented positions shall be approved by EPZ.
- Suggestion is given to the plant to establish a common documented understanding with the regulator which NVR-rules should be selected and in what time perspective these different documented EPZ positions should be ready.
- Recommendation is to perform review, revision, and roll out of [the planned] Borssele modification processes ensuring the following:
    - clear instructions exist for clarifying boundaries between parts substitutions, small modifications, temporary modifications, and large modification.
    - appropriate design oversight is applied to parts subsitutions and modifications (including temporary modifications) to ensure station design requirements, codes, standards, and program requirements are met,
    - modification processes ensure that required revisions to Borssele ageing management and other key site programs are assessed and implemented.
- Recommendation is to define a managed process within the EPZ management system to address processing of technical documents prepared by external companies.
- Recommendation is to implement a programme for monitoring environmental conditions that secure that the temperatures used in the ageing analyses over time stay conservative.
- Recommendation is to prepare a report with the results of the revalidation of the Time Limited Ageing Analyses (TLAAs) of electrical en I&C components.
- Recommendation is that the scoping report used in the LTO programme should be updated to better reflect the criteria provided for scoping in the IAEA recommendations
- Recommendation is that the plant should finalize the methodology for the assessment of active components for the LTO in line with the LTO B project schedule.
- Suggestion: INPO AP 913 represents a good international practice; the plant should consider its implementation in close coordination with LTO, in particular considering that the maintenance programme constitutes an essential part of ageing management at the plant.
- The team recommends to the plant that the Organizational structure and Staffing disposition, including numerals and knowledge, is reviewed and enhanced in order to be well adapted and developed for the proper handling of the work associated with Long Term Operation and Ageing Management.
- The team recommends to the plant that the Management system documents, including all documents required to perform the Scoping and Screening work, are reviewed and amended in order to be well adapted and developed to handle all the issues involved in managing Long Term Operation and Ageing.

- The team suggests to the plant to implement a document within the Management system which describes the Ageing Management strategy.
- Suggestion is given to the plant to develop a document within the Management system that describes the integration of the Ageing Management within the Long Term Operation.
- Suggestion is to follow a formal procedure to assess and modify ageing management program changes from the evaluation to the impact on the plant components.
- Recommendation: A review should be conducted to determine if other identified ageing mechanisms from the ageing management review have been removed from evaluation or been missed in implementation.
- Recommendation: The plant equipment database should have ageing management programs/mechanisms identified and tracked for required inspections.
- Suggestion: Add cavitation to the Ageing Management Catalogue of Ageing Mechanisms for Mechanical components and screen to determine if there are any susceptible components.
- Suggestion: Consider expediting implementation of the INPO AP-913 (Equipment. Reliability Process) or similar process at Borssele for equipment, component, and programme surveillance.

Good Practices identified during SALTO-2012 were among others:

- Use of risk matrix
- Evaluation of training effectiveness
- Use of colour coding in the Periodic Safety Review (10EVA13)
- TLAAs revalidation
- Chemistry Programme
- Component chain
- Civil structure integration into equipment database

b. IPSART follow up mission 2013 Findings

In 2010 there was an IAEA International Probabilistic Safety Assessment Review Team (IPSART) Mission for the Level 1, Level-2 and Level-3 Full-scope Probabilistic Safety Assessment (PSA) study for the Borssele NPP in the Netherlands. In 2013 (April 15 – 22) there was an IAEA Follow-up IPSART Mission to BORSSELE NPP for the full scope Level 1, Level-2 and Level 3 PSA. The follow-up missions generally provide a limited scope review, the main objective being to ensure an adequate treatment of the IPSART mission recommendations and draw final conclusions.

More specifically the objectives of the 2013 mission were:

- To review the updated PSA model and documentation;
- To check how the IPSART mission recommendations (of the 2010 mission) have been addressed in the reviewed version of the Level-1 through Level-3 full-scope PSA for the Borssele NPP;
- To ensure adequate treatment of the IPSART mission recommendations;
- To draw final conclusions on the PSA quality and applicability in decision making.

An additional objective requested by the Regulatory Body (RB) was to advice on how the External Events PSA could be further enhanced to capture the aspects of extreme events that were highlighted by the Fukushima Daiichi accident.

The general conclusions were:

- The efforts of EPZ's PSA team spent on improving the PSA quality is impressive.
- There is a major improvement of the model and the associated documentation;
- Most of the IPSART 2010 recommendations are implemented into the Living PSA (LPSA);

- The LPSA model has the potential to serve all of the intended applications.
- The analysis of external hazards is done according to international standards, the methodology used is approved. In particular the qualitative and quantitative screening process according to IAEA Safety Guide SSG-3 has been performed in detail. Necessary data for the quantification are generally available which facilitates an easy update.

Issues documented in IPSAR can have four types of classifications:

- ‘HIGH’ Failure to resolve this issue will compromise the results of the PSA as a whole; or, may prevent a major objective of the study from being satisfied. Alternatively, failure to resolve this issue will preclude meaningful use of the study for an intended application.
- MEDIUM’ Failure to resolve this issue will compromise the quantitative aspects of a particular portion of the model, but does not necessarily have a significant impact on the overall results of the study. Alternatively, failure to resolve this issue limits the fidelity of the study for certain applications.
- ‘LOW’ This category generally captures differences of opinion. Failure to resolve this issue is not anticipated to have a significant quantitative impact on the PSA model, nor results calculated with the model. Failure to resolve this issue will not prevent meaningful use of the study for most applications.
- ‘N/A’ The issue is resolved and no further action is needed, i.e., no recommendations by the reviewer are associated to this issue.

The number of issues dropped from 87 to 32. Of these 32, 25 were classified as having ‘low importance’ and 7 were classified as having ‘medium or medium/low’ importance.

Some issues are listed below.

The resolution of the issues in relation with the heavy load analyses would clarify the potential consequences of certain heavy load drops, and therefore would help the plant to improve the safety of the heavy load hoisting activities.

Some parts of the PSA analysis may yield too conservative results. This is in part due to simplicity of the modelling particulary of human reliability. This results in slowly developing scenarios where there are actually many opportunities for mitigating actions. This has to be taken into account when using PSA results to support decision-making.

The presentation of results in the PSA documentation is not conducive to communication of PSA insights. Recommendation is to develop a plain English presentation format based on communicating the high level insights rather than detailed tables which may change even with minor updates to the model.

The finding related to the justification of dike failures, including of dike failures directly in the flooding analysis might be resolved due to the planned revision of the external flooding model. Due to this planned revision of the external flooding PSA model, a review of the old model was not reasonable and has not been performed. The update of the PSA documentation should describe clearly the chosen external flooding PSA model, the scenarios investigated and should take into account appropriate actual data.

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